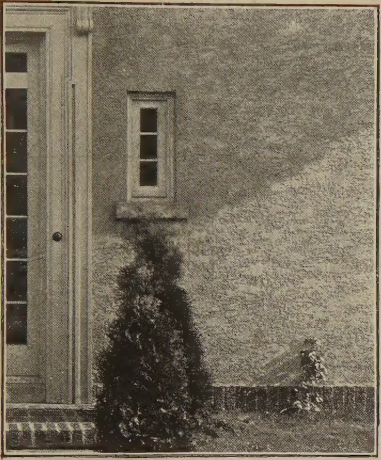
Cement MILL EDITION of

# Concrete

Monthly Magazine of the Construction Field

Januar

1922



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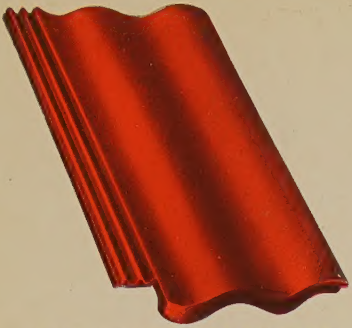

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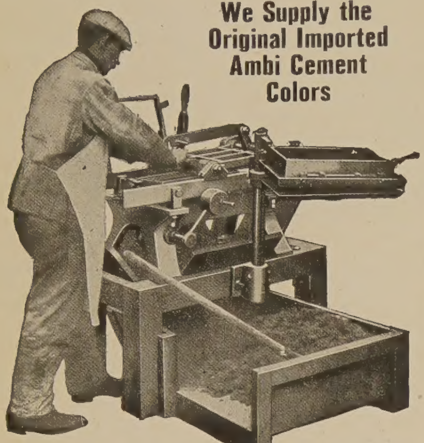

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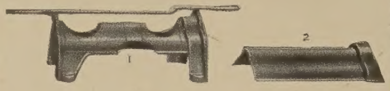

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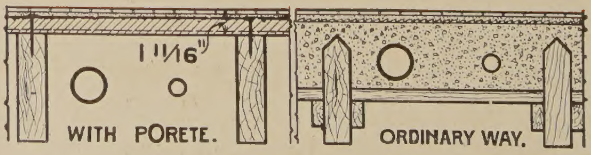

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Cement MILL SECTION of

Concrete

Vol. 20 JANUARY, 1922 No. 1

# Cement Plant, Crushing Plant and Wharf of Petoskey Portland Cement Co.

By Edward McKeehan Johnston

The new 2,000 bbl. plant of the Petoskey Portland Cement Co., which was started on March 23, 1921, last, has attracted unusual attention because of being the first wet process plant to obtain all of the power required for operating the entire works from the waste heat boilers, and also because of its going so promptly to full capacity after starting, and increasing steadily month by month until in September a capacity of 68,000 bbls. was obtained.

The Petoskey Portland Cement Co.'s property is located on the south shore of Little Traverse Bay, about three miles west of Petoskey, and embraces some 400 acres of property located along about 2½ miles of shoreline. Little Traverse Bay is located on the east shore of Lake Michigan, about 40 miles south of the Straits of Mackinac. The entire property of the company is underlaid with very pure and uniform limestone that is not only particularly well suited to the manufacture of cement, as well as other chemical and metallurgical purposes, but, on account of being exceptionally hard, is a stone that also meets with a ready sale for road work and general construction purposes. The quarry property has been operated something like 20 years, and during the last 12 years has supplied all of the stone used by the Newaygo Portland Cement Co., of Newaygo, Mich., which is located 186 miles down the line of the Pere Marquette Ry.

The new crushing plant of the Petoskey company is located about 1,500 ft. west of the cement plant and about 50 ft. from the shoreline of Little Traverse Bay. It is equipped with a No. 12 Gates crusher,[1] two No. 9 elevators, and four 60 in. in diameter by 22 ft. long, revolving screens. Four No. 5 gyratory crushers are provided for recrushing the oversize from the No. 12 crusher, and all of the crushers are located in the same room, to the south of the bins and screen house, the bins being so arranged that the oversize from the screens falls by gravity to the south row of bins, from which it may be shipped in railroad cars passing underneath the bins, or may be passed on to the No. 5 crushers for further reduction.

The entire structure of the crushing plant is of structural steel, with concrete floors in the crusher room and concrete walls and bottoms for the storage bins. The storage bins are divided into 12 compartments, and have a total capacity of 1,600 tons, and there are three tunnels under the bins provided with standard gauge tracks.

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[1] Allis-Chalmers Co., Milwaukee, Wis.

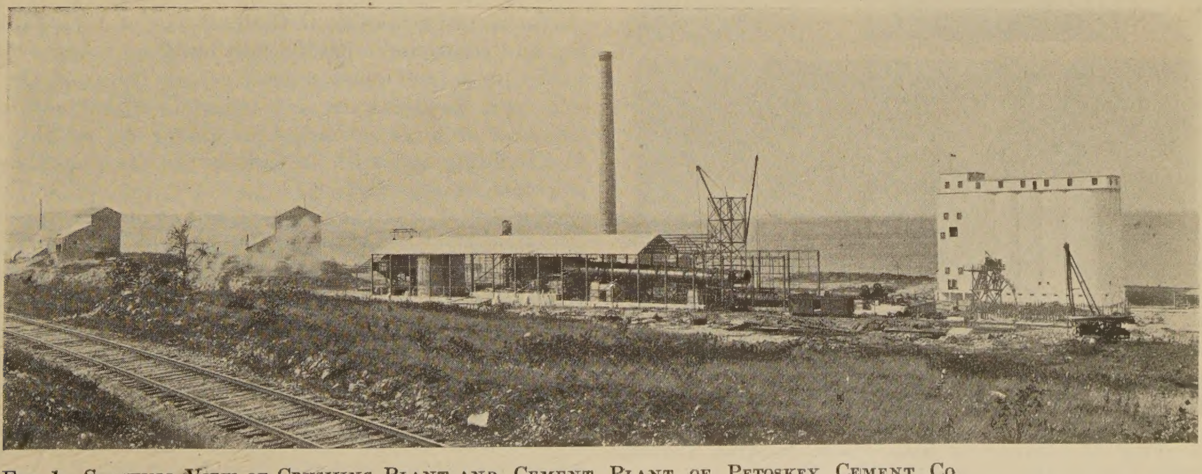

Fig. 1—Showing View of Crushing Plant and Cement Plant of Petoskey Cement Co., From the South. Old Crushing Plant at the Left, New Crushing Plant at the Right

An unusual feature of the crushing plant is that the entire plant is operated with a 400 h. p., 440 r. p. m., 2,300 volt, 3 phase, 60 cycle motor, from which power is transmitted to the main line shaft of plant by a Link-Belt silent chain drive[2] of unusual size, that is completely enclosed and operates in an oil bath.

The Petoskey company employs gasoline operated well drills in the quarry, which is located to the west of the crushing plant, and will ultimately have a face of about 1½ miles and of an average height of about 35 ft. The stone is loaded by Vulcan shovels[3] of 70 and 85 tons size, respectively, into 7 yd. side dump Russell cars, which are hauled in trains of five to seven cars by standard gauge 40-ton saddle tank locomotives. These trains on approaching the crushing plant ascend a grade of about 2%, and pass directly back of the No. 12 crusher, dumping their load directly into the hopper of the same.

The crushing plant is unusually well arranged and compact, which accounts for the small size of the building, the ground space occupied being only 48 ft. by 100 ft., and, by reason of the compact and convenient arrangement of the plant, but very few men are required for operating it. The crushing plant was designed to furnish stone for both the Petoskey cement plant and the Newaygo plant, as well as 1,000 to 1,500 tons daily of commercial stone.

The cement plant is located approximately parallel with the shoreline of Little Traverse Bay, and about 500 ft. from the water's edge, the main building of the plant being about 50 ft. wide by 500 ft. long, followed by an open space about 50 ft. to the east, and a building about 50 ft. wide by 72 ft. long which houses the coal mill.

Adjoining the north side of the main mill building about one-third of the distance from the west end is located a building about 42 ft. wide by 71 ft. long in which the turbine station and auxiliary boiler room are located, and about 50 ft. to the north of this building is a building about 67 ft. wide by 122 ft. long serving as shops, warehouse, plant, office and laboratory.

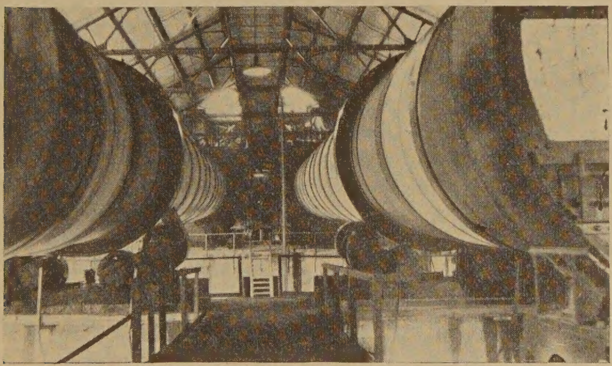

Fig. 2—View of Interior of Kiln House Looking Towards Discharge End of Two 10′ x 150′ Rotary Kilns

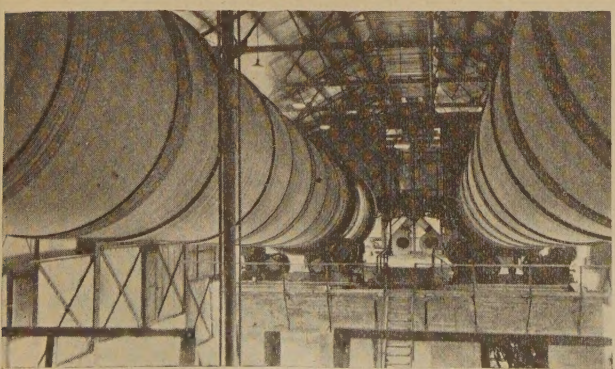

Fig. 3—View of Interior of Kiln House Looking Towards Feed End of the Two 10 ft. by 150 ft. Rotary Kilns

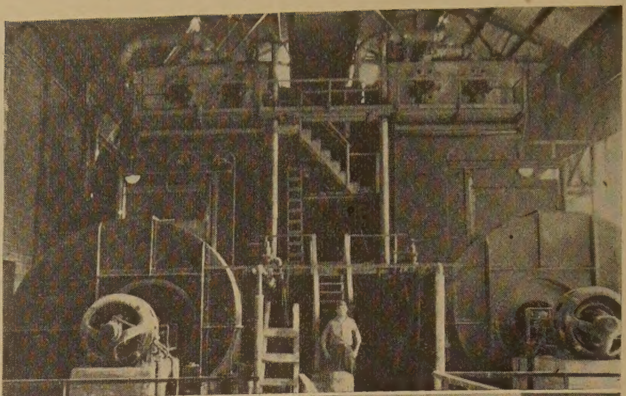

Fig. 4—Fans and Edge Moor Waste Heat Boiler

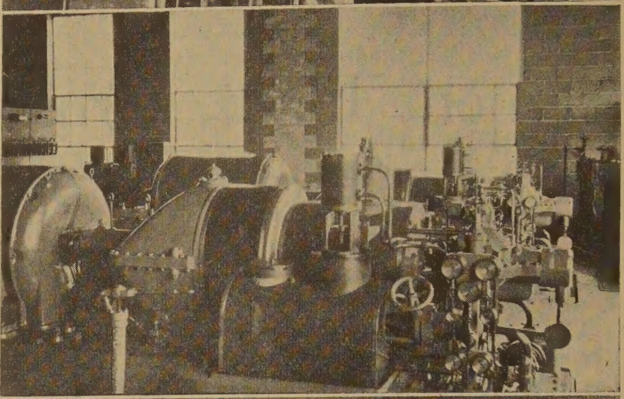

Fig. 5—View of Power House Showing Two 1000 K. W. 2300 Volt, 3 Phase, 60 Cycle Turbo Alternators, 3600 R. P. M.

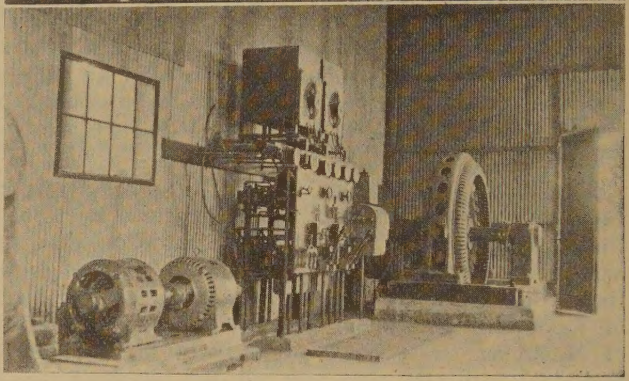

Fig. 6—400 H. P., 3 Phase, 60 Cycle, 2200 Volt Synchronous Motor for Driving No. 722 Compeb Mill, Also Motor Generator Set for Excitation for Two Motors

About 100 ft. north of the east end of the mill building and connected with the mill building by an overhead bridge is a reinforced concrete stock house of the deep silo type, having a capacity of 100,000 barrels, and to the west of the stock house adjoining the packing room is a building about 67 ft. wide by 96 ft. long for cleaning and storing bags.

About 700 ft. to the east of the stockhouse there is a concrete dock about 400 ft. long having 23 ft. of water at the dock edge, which is sufficient to accommodate any boats now sailing on the Great Lakes, and over which the company is now shipping cement and receiving coal from the vessels of the Petoskey Transportation Co., an allied concern.

The quarry, crushing plant, cement plant stockhouse and dock are all served by well arranged standard gauge tracks connecting with the Pere Marquette Ry., near the south end of the company's property, and upon which the company do their own switching with a 50 ton

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[2] Link-Belt Co., Chicago, Ill.

[3] Vulcan Iron Works, Wilkes-Barre, Pa.

American saddle tank locomotive.

The storage for raw material for the cement plant consists of a trestle about 35 ft. high and 400 ft. long, underneath which there is a concrete tunnel housing a 24″ belt conveyor for taking raw material into the mill. The stone from the crushing plant is hauled in 15 yd. air operated side dump cars by the 50 ton switcher mentioned above and dumped from this trestle, while shale from the company's pit at Ellsworth (about 18 miles south and west of the plant) arrives over the Pere Marquette Railway in drop bottom cars which are run out on the trestle and dumped in seperate piles from the stone. The raw storage is at present open, but provision has been made for covering the same in the future.

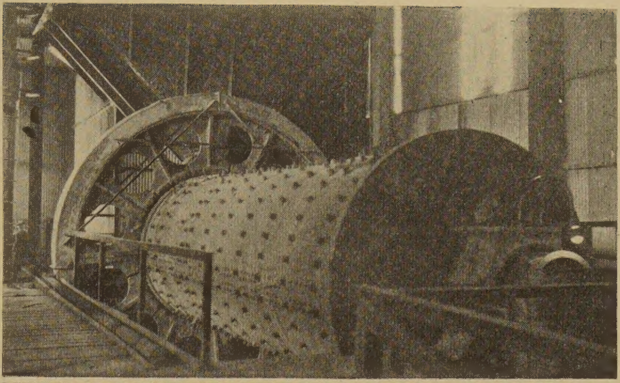
About every 15 ft. in the roof of the tunnel under the raw storage pile is a quadrant type gate through which either stone or shale is drawn into traveling measuring hoppers, which straddle the belt conveyor taking raw material into the mill and by means of which hoppers the proportions of stone and shale are gauged.

The 24″ belt conveyor from the raw storage pile discharges into a No. 6 Gates crusher type elevator which raises the raw material and discharges into the storage bins back of the raw compeb mills. These bins are constructed of steel and have a capacity of aboct 500 tons. The raw material flows by gravity directly into the feeders of the compeb mills which are located below and immediately in front of the bins.

The two Allis-Chalmers Mfg. Co. compeb mills used for raw grinding are 7 ft. in diameter by 22 ft. in length and are each driven by a 400 H.P. 2300 volt, 3 phase, 60 cycle synchronous motor operating at 180 R.P.M. through a single countershaft on which there is located a Cutler-Hammer magnetic clutch[4] which permits starting the motors under no load and then picking up the mill or stopping them by the simple throwing of a small knife switch and operation of a small rheostat. The two 400 H.P. motors are located in a separate room from the compeb mills, in which there is also housed the controlling switchboard for the motors and a 25 K. W. motor generator set for supplying the exciting current for the motor fields and the magnetic clutches.

The slurry flows from the compeb mills into a pond about 6 ft. wide by 30 ft. long by 8 ft. deep located below the floor and directly in front of the compeb mills. From this pond the slurry flows to a displacement type compressed air slurry pump by means of which the slurry is elevated and distributed to any one of six reinforced concrete slurry tanks having 20 ft. in diameter by 40 ft. high having a total capacity of over 6,000 barrels of slurry. Means are provided for agitating the slurry in these tanks with compressed air and also by means of a second compressed air pump. The slurry may be interchanged or mixed between any number of tanks as well as passed on to two concrete slurry feed tanks 20 ft. in diameter by 20 ft. high, located underneath the feed end of the kilns and from which the slurry is ordinarily taken by a third compressed air pump and delivered to the feed trough above the kilns, but, if occasion demanded, slurry may be delivered from the pump located at the slurry tanks directly to the feed trough of the kilns.

The two kilns of the plant are each 10 ft. in diameter by 150 ft. long and are mounted high so that the clinker flows by gravity into two coolers which follow the kilns and set under the firing floor of the kilns. Both kilns and coolers were furnished by the Allis-Chalmers Mfg. Co. Particular care has been taken to conserve heat throughout the entire kiln installation, air seals being provided on the upper end of the coolers and an angle iron ring placed around the lower end of the kilns to run close to the hood in order to reduce the infiltration of cold air at these points so far as practical, as it is intended that all air for combustion in the kilns other than that blown in with the fuel shall be drawn through the coolers and thus preheated as much as possible. Air seals are also provided at the upper end of the kilns to reduce the infiltration of air in to the gases going to the boilers to a minimum. The kilns have also been provided with Sil-o-cel insulating brick[5] linings between the firebrick lining and the shell for the full length of the kilns, with the exception of the firing zone and about 10 ft. at the feed end. As a result of the great care exercised in this plant to conserve heat the temperature of the gases passing to the boilers are much higher than it has heretofore been thought possible to obtain in a wet process plant, and this feature is largely responsible for the company being able to obtain all of the power required for the operation of the entire works from the waste heat of the kilns.



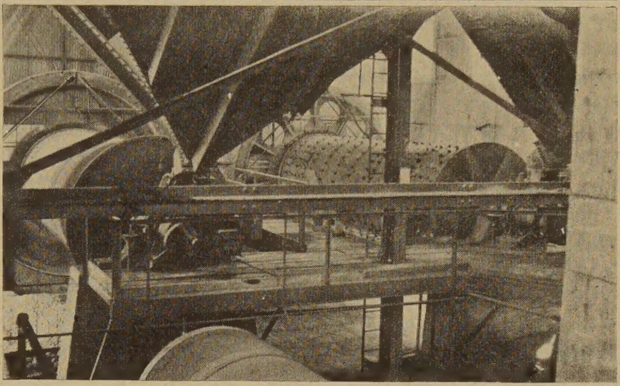


Fig. 7—No. 722 Wet Grinding Compeb Mill
Fig. 8—No. 722 Clinker Grinding Compeb Mills

The kiln housings, as well as the connecting flues to the boilers, are constructed of reinforced concrete, lined with fire brick and insulated with Sil-o-cel brick placed between the fire brick and the concrete.

The two Edge Moor waste heat boilers[6] sit directly back of and in line with the kilns and following each boiler is a Green economizer[7] and a Green fan driven by a 75 H. P., 2300 volt, 3 phase, 60 cycle motor, provision being made in the controlling apparatus of these motors for 30% variation in speed, so that the draft on the kilns can be regulated to secure most efficient operating conditions.

The two draft fans discharge into a brick lined tunnel below the boiler room floor which conveys the gases to a similar cross tunnel passing under the kiln housings and thence on to the base of a 10 x 200′ concrete stack located just outside of the mill building. Means have been provided for passing the gases from the kilns directly to this stack and shutting off the entire waste heat boiler installation conveniently, at any time it became necessary or desirable to do so.

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[4] Cutler-Hammer Mfg. Co., Milwaukee, Wis.

[5] Celite Products Co., New York City.

[6] Edge-Moor Iron Co., Edge Moor, Del.

[7] Green Fuel Economizer Co., Beacon, N. Y.

The boiler room floor is about 10 ft. above the basement floor level, which provides ample room below the flues, boilers and economizers for brick lined concrete hoppers in which the dust carried over from the kilns is deposited. The amount of dust made to date in this mill is surprisingly small, as will be appreciated when it is stated that one man with a wheelbarrow takes care of all the dust in a few house out of the day, this dust being drawn from above mentioned hoppers through suitable gates and at present merely wheeled out into the yard, as means have not yet been provided for returning it to the kiln feed. The company contemplates providing apparatus in the future for mixing this dust into a slurry and returning it to the kilns.

The turbine room is a concrete and steel structure located adjacent to the waste heat boiler room, and in it there are installed two Allis-Chalmers 1250 K.V.A. 2300 volt, 3 phase, 60 cycle, 3600 R.P.M. turbo-generators equipped with jet condensers located immediately below the turbines, having steam driven air pumps and electrically driven circulating pumps. The cooling water for the condensers flows by gravity from Little Traverse Bay through a concrete tunnel to the cold well below the condenser room floor and the discharge from the condensers flows from the hot well back to Little Traverse Bay through a 24″ reinforced concrete pipe laid beneath the yard level, so that excellent and economical means have been provided for an ample supply of cold condensing water at all times.

The length of the steam line from the waste heat boilers to the turbines is unusually short and long radius pipe bends have been employed throughout in place of elbows, as a result of which there is an unusually small drop of both steam pressure and steam temperature between the boilers and the turbines. The boilers were designed for 170 lbs. steam pressure and 100° superheat, and it was expected that there would be sufficient steam to run the entire works by carefully balancing the various loads throughout the day and night shifts. In operation, quite a little excess steam has been produced to date; in fact, so much that the blowing of the safety valves became a nuisance and mufflers have been installed on them, and it has further been found that the superheat in the steam averages better than 125°, which, of course, contributes to economy in the turbines and helps to explain the excellent results being secured by the plant.

The turbo-generators are controlled from a well equipped black slate panel switchboard having separate panels for the exciters, each of the generators, the raw compeb mills, finishing compeb mills, crushing plant, small motor transformers and lighting system. The 2300 volt current from the generators is reduced to 460 volts pressure by three-333 K.V.A. transformers located in the basement of power house for serving the smaller motors throughout the plant. The 460 volt current is distributed through a separate switchboard setting alongside of the 2300 volt board on the main floor of the station. All motors of 50 H.P. and smaller in size throughout the plant are operated on 460 volt pressure; all larger motors on 2300 volt current. The distribution of current throughout the mill is carried out by three conductor cambric insulated cables carried in iron conduit to main distributing centers and thence to the various motors through rubber covered wire carried in iron conduit, and the entire distributing system is particularly conspicuous because of its simplicity and neatness.

In the basement of the power house there are also located two 12 x 10 Ingersoll-Rand motor-driven air compressors[8] for furnishing compressed air at 100 lbs. pressure for the handling and agitation of slurry in the mill, one of which compressors is automatically started and stopped with the variation of pressure and the other equipped with a suction governor. In the basement of turbine station there are also two-12 x 7 x 12 American outside packed plunger feed pumps, and two-12 x 10 x 12 American piston type service pumps[9] for general water supply, all of which pumps are equipped with Fisher pump governors[10] controlling them automatically. Directly over the feed pumps on the main floor of the turbine station is located a Cochran open type feed water heater[11] which receives the exhaust steam from the condenser air pumps, feed pumps and general service pumps and raises the temperature of the feed water going to the waste heat boilers to about 200° F.

On the main floor of turbine station there is a black slate switchboard completely equipped with temperature and draft controlling instruments serving the waste heat boiler plant, also the recording and indicating instrument of a venturi meter which measures the feed water going to the waste heat boilers, and, from the readings of these instruments, as well as those on the electrical switchboard, a complete log of the operation of the plant giving hourly readings is returned by the operat-

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[8] Ingersoll-Rand Co., New York City.

[9] American Well Works, Aurora, Ill.

[10] Fisher Governor Co., Marshalltown, Iowa.

[11] H. S. B. W. Cochrane Corp. Philadelphia, Pa.

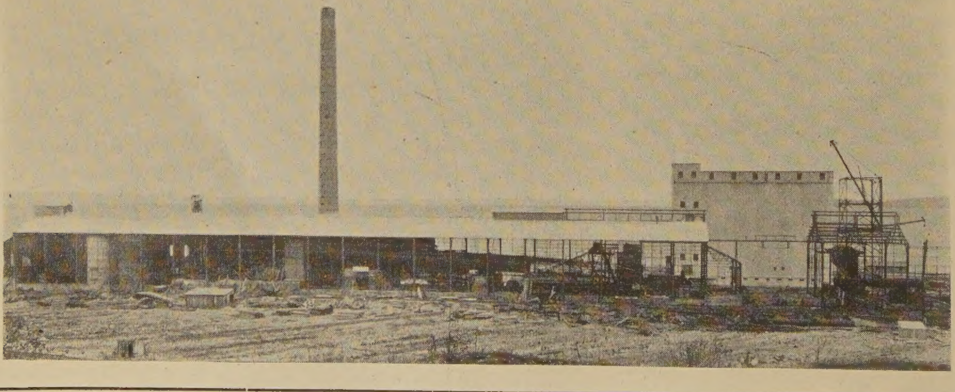

FIG. 9—GENERAL VIEW OF PLANT FROM THE SOUTH. STARTING AT LEFT THE DEPARTMENTS ARE: MOTOR ROOM; RAW COMPEB; SLURRY TANKS; WASTE HEAT BOILERS; KILNS; COOLERS; CLINKER BINS; COMPEBS; MOTOR ROOM; OPEN YARD SPACE; COAL MILL; STOCK HOUSE BEYOND

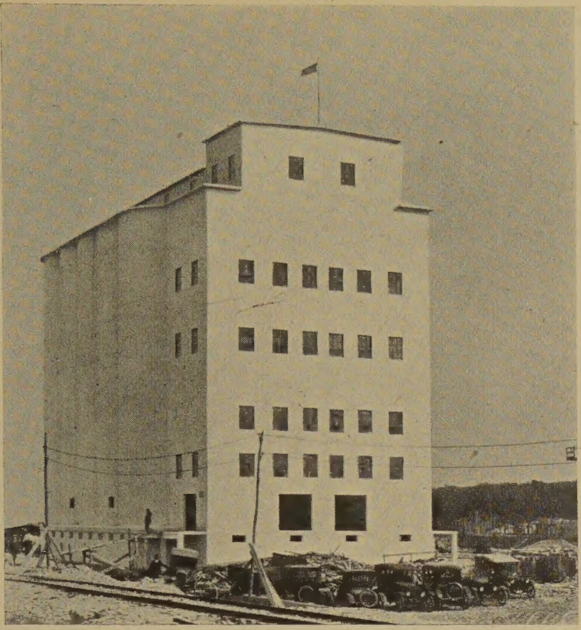

FIG. 10—THE COMPLETED STOCK HOUSE CONSISTING OF A GROUP OF SILO STORAGE BINS AND CLOSED INTERSTICES

ing engineers to the superintendent at the close of each day.

The turbine station is served by a hand operated traveling crane and is as completely and neatly finished throughout as the best of modern public service stations. A very interesting feature in connection with the turbo-generators is the provision in the air ducts for drawing air into the generators from the outside or from the basement, as weather conditions require, and for discharging the heated air from the generators either to the outside of the building, the basement of the turbine station, or into the main mill building.

Adjacent to the turbine station is a building about 24 x 42′ in size, in which is located a 300 H.P. hand-fired Edge Moor water tube auxiliary boiler served by the main chimney of plant through an underground concrete brick-lined flue. This boiler is used for starting up the plant or operating the turbine station at times when the kilns are shut down. A non-return valve in the steam line from this boiler to the main header automatically cuts out the auxiliary boiler at any time the waste heat boilers are furnishing sufficient steam for the turbines. With both kilns in full operation it has never been found necessary to use the auxiliary boiler.

Attached to the lower end of each cooler is a perforated screen having 1½″ round holes, so that all the clinker discharged from the coolers must be smaller than 1½″. An angle iron flange at the lower end of this screen keeps larger pieces of clinker from rolling out of the end of the screen and a cast iron ball about 8″ in diameter rolling around in the screen against this angle iron flange serves to break up what few large pieces of clinker are discharged from the kilns. Due to the fine grinding of raw material in the compeb mill and the uniform composition of the feed to the kilns by reason of the wet process, very uniform and small clinker is discharged by the kilns; in fact, the bulk of the clinker is smaller than ½″ in size.

The clinker falls directly from each of the above mentioned screens through a hopper shaped feed chute into a 24″ Peck carrier supplied by the Link Belt Company, which raises the clinker about 40 ft. and discharges it into the bins of the finishing mill, or the clinker may be carried on by this carrier out through the side of the building and discharged into a storage pile over which the carrier passes on a steel bridge. The clinker from this storage pile is recovered by the same carrier passing through a concrete tunnel on its way back to the coolers. The clinker ordinarily is discharged from the coolers sufficiently cool for immediate grinding, but, when too hot for immediate grinding, a small spray of water is played on the clinker just inside the discharge end. Contrary to expectations, this spraying of the clinker inside the coolers seems to have no effect on the kilns. The coolers are lined with fire brick throughout, but are not provided with any lifters.

The clinker bins feeding the compeb mills are of about 500 tons capacity, constructed throughout of steel and provided with a steel cover, various slides being provided in the cover for openings through which the clinker from the Peck carrier falls. The two compeb mills used for finishing were furnished by the Allis-Chalmers Mfg. Co. and are 7 ft. in diameter by 22 ft. long and each driven by a 400 H.P., 2300 volt, 3 phase, 60 cycle, 180 R.P.M. synchronous motor transmitting through a magnetic clutch of the same size and design described above in connection with the raw mills. Both of these motors are located in a room adjoining the mills in which there are also the controlling switchboards for the mills and a 25 K.W. exciter set for furnishing current to the fields of the motors and the magnetic clutch.

The finished cement discharged from the compeb mills falls through a closed chute to a 14″ chain type bucket elevator contained in a concrete casing and sitting midway between the two mills. This elevator raises the cement about 50 ft. and discharges into a 16″ screw conveyor running across a steel bridge to the stockhouse. This screw conveyor and the above mentioned elevator are driven by a 20 h. p., 3 phase, 60 cycle, 440 volt, 720 R.P.M. motor through a Link Belt silent chain drive to a jack shaft at the head of the elevator running at 115 R.P.M., from which power is transmitted to the elevator head shaft by a No. 4103 chain running on No. 103 sprockets. The elevator head shaft is provided with take-ups and the top of the concrete elevator casing is covered with a light steel hood which is readily removable for making repairs. Power is transmitted from the end of elevator head shaft to the 16″ screw conveyor by a No. 103 chain. The above mentioned motor, jack shaft and elevator head shaft are mounted on a structural steel framework setting on top of the concrete elevator casing which is extended to provide a platform around the elevator head and makes a very compact, simple and convenient arrangement. This same design of elevator casing and head gear are standard throughout the stockhouse and coal mill. The concrete casings are unusually large, giving ample room for the swing of the elevator chain and for removing and attaching buckets or making other repairs at the bottom of the casing, where a steel door the full width of the casing and 6′-6″ in height is provided. The elevator boot shaft passes through the side of the concrete casing and rests in pillow blocks carried on concrete piers at either end. Dust collars are provided at the sides of the casing for both head and foot shafts, and there is no dust escaping from the elevators.

A standard gauge railroad track parellels the mill building on the north side and under this track opposite the discharge end of the coolers is located a track hopper through which gypsum is fed onto a belt conveyor that takes it into the center of the mill, where a bucket elevator of the same general design as described above raises it about 40 ft. and discharges it into a screw conveyor which carries the gypsum over to a steel bin having a capacity of about 60 tons, located in line with and alongside of the clinker bins. From the bottom of this bin gypsum is automatically fed onto the Peck carrier conveying the clinker to the finishing mill bins. Another screw conveyor extends from the head of the elevator to the outside of the building, where it discharges into a concrete storage bin about 20 ft. in diameter by 35 ft. high, where a reserve supply of gypsum is kept. The above mentioned belt conveyor from the hopper passes through a tunnel under this bin, so, when gypsum is desired from the bin it can be carried into the mill the same is if it came from the track hopper.

The coal mill, as mentioned above, is located in a separate building about 50 ft. from the end of the plant proper. The above mentioned track paralleling the plant passes over a large concrete track hopper just outside the coal mill, through which coal is fed by shaking feeder onto a 30″ belt conveyor running up an incline into the coal mill and discharging into a 24″ Link Belt double roll crusher, from which a short belt conveyor provided with a magnetic head pulley for removing tramp iron conveys the coal to a 14″ bucket elevator in a concrete casing. This elevator raises the coal and discharges it into a steel bin of about 60 tons capacity, from which it is fed by a screw conveyor feeder into a 5 x 50 ft. Allis-Chalmers "Ebro" type coal dryer. The dried coal falls through a chute into a 14″ bucket elevator in a concrete casing, which raises it about 40 ft. and discharges into a 12″ screw conveyor distributing the coal into three steel bins feeding the Fuller mills[12]. Three 42″ Fuller mills driven by 75 H.P. vertical motors are used for pulverizing the coal, two of these mills having ample capacity to take care of the plant, the third mill being installed as a spare. The pulverized coal is conveyed by a 12″ screw conveyor to a third 14″ elevator in a concrete casing, which raises the coal about 40 ft. and discharges into a 12″ screw conveyor which runs across a bridge into the mill proper and thence to bins on the kiln firing floor.

There are two bins on the kiln firing floor each of about 12 tons capacity, from the bottom of which the powdered coal is drawn by a 4″ screw conveyor operated through bevel gearing and a system of cone pulleys, which permits easily and quickly changing the feed to suit conditions. Two Bayley multivane fans each driven by a belt from a 40 H.P. motor set on the firing floor immediately back of the bins furnish the blast for blowing the powdered coal into the kilns. Only one of these fans is used at a time, the other being kept in reserve. The coal bins are set back some 30 odd feet from the kiln hoods, and large double doors are provided on both sides of the building, so that excellent ventilation has been provided for on the firing floor.

The main mill building and coal house are constructed throughout of steel and are covered both on roof and sides with corrugated iron. Steel frame windows are provided in the motor room, but in the balance of the building large shutters are used in place of window openings. These shutters are about 4 x 8 ft. in size and are pivoted at top and bottom, so that they may be opened or closed as much as desired to admit ventilation and light. A very unique feature in the design of the buildings is that the lower 8 ft. of siding of the bcilding is carried on steel frames which are arranged to slide vertically on the columns, thus making it possible to open at any time practically the entire building for a height of 8 ft. for ventilation or for access to the building.

The stockhouse is a reinforced concrete structure consisting of six main bins each 32 ft. in diameter by 71′-6″ high, arranged in two rows of three bins each, thus providing two auxiliary bins in the interstices. The interstices between adjoining bins on the outside of the building are connected by short curved walls, thus providing five additional auxiliary bins and pretty nearly bringing the capacity of the stockhouse up to entire surface of the ground occupied, notwithstanding the curved shape of all bin walls.

Adjoining the west end of the stockhouse is a reinforced concrete structure known as the workhouse, which is 54 ft. wide by approximately 20 ft. long, the ground floor of which is occupied by the Bates packing machine, the second floor by the bins over the Bates machine, the third floor by weighing equipment for shipping bulk cement, the fourth floor by screens for preparing cement for the Bates machines[13], and the fifth floor, which is at a level with the top of the storage bins, by the elevator heads and screw conveyors distributing the cement from the mill into the bins. A concrete penthouse 38 ft. wide by about 9 ft. in height extends from the above described structure the full length of the top of the storage bins covering the two lines of screw conveyors for distributing cement from the mill into the bins.

As mentioned above, the finished cement from the mill is carried to the stockhouse in a 16″ screw conveyor running across a steel bridge about 50 ft. above the ground level. This conveyor discharges at the stockhouse end into a 14″ bucket elevator, the boot of which rests upon the third floor of the workhouse, which raises the cement to the top of the workhouse, where it is discharged into a 16″ screw conveyor running the full length of the south row of bins, or into a 16″ cross conveyor, which in turn discharges into a 16″ conveyor running the full length of the north row of bins.

Instead of tunnels commonly employed under stockhouses for accommodating the conveyors taking the cement from the bins, the Petoskey stockhouse has a basement 8 ft. high under the entire structure, well lighted and ventilated by windows on all four sides of the building. This basement permits 24 openings in the bottom of each bin, with necessary chutes running to four lines of 12″ screw conveyors for removing cement from the bins. This very roomy, light and airy basement must be seen to be appreciated.

The four lines of 12″ screw conveyors under the bins in the basement of the stockhouse discharge into two-16″ cross conveyors at the workhouse end, which in turn discharge into a 14″ bucket elevator carried in a concrete casing, that raises the cement to the screens mentioned above over the Bates machines. The Bates machines are elevated well above the floor, are each driven by a direct connected 20 H.P. motor and are each provided with 30″ belt conveyors for tranporting the sacked cement to the cars on loading tracks that pass each side of the stockhouse. On each side of the workhouse at the Bates machine floor level is a concrete platform about 7 ft. wide, which parallels the loading tracks and extends west the full length of a building 67 ft. wide by 96 ft. long, constructed of steel and concrete, and used for cleaning and storing bags.

Directly in line with the stockhouse and about 150 ft. west of the bag cleaning building is a steel and concrete structure about 67 ft. wide by 122 ft. long, serving as shop, warehouse, plant office and laboratory. Running

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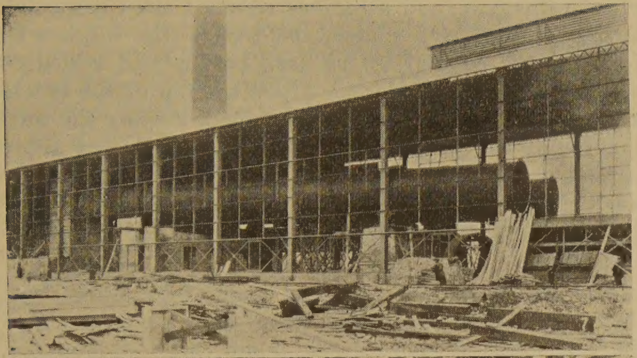
[12] Fuller-Lehigh Co., Fullerton, Pa.

[13] Valve Bag Co. of America, Toledo, O.



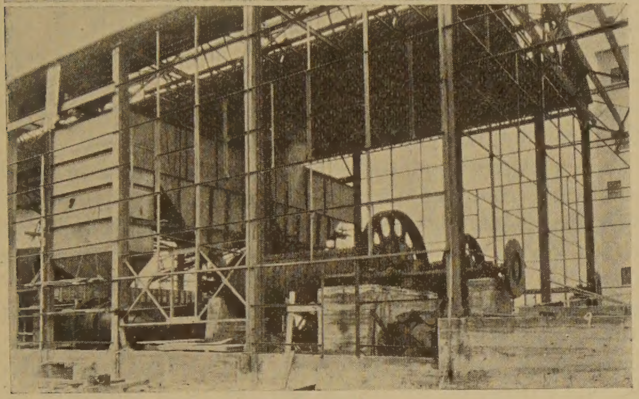


FIG. 11—TWO 10′ x 150′ ROTARY KILNS BEING INSTALLED. WASTE HEAT BOILER FOLLOWING KILNS

FIG. 12—CLINKER STORAGE BINS; CLINKER GRINDING COMPEB MILLS; GYPSUM BIN AT LEFT OF CLINKER BINS

into this building from a switch on one of the stockhouse loading tracks is a standard gauge siding, by means of which any of the railroad equipment, steam shovels, or cranes, or heavy machinery may be run into the shop. On the inside of the shop this track passes over a repair pit about 50 ft. long by 6 ft. deep, which is ordinarily covered by a removable plank floor. The machine shop occupies 72 ft. of the length of the above building and is separated from the next bay which is used as a storeroom by a latticework partition, the storekeeper in charge of the warehouse having his office at the south side of the building, where waiting space is provided outside the storekeeper's office for the convenience of men coming from the mill for supplies. The west 24 ft. of the building is completely closed off by beaver-board partitions and divided up to provide a private office for the superintendent, a general office for the clerks, a physical laboratory and a private office for the chemist. It will be noted that the shop space can be approximately doubled if required at any time in the future by removing the warehouse and offices to a separate building and simply taking out the partitions.

The shop is well equipped with several sizes of lathes, a shaper, planer, standard drill press and a large radial drill press, which latter machine is especially useful, as it has a reach of something like 5 ft. and can be used not alone for drilling operations, but also for boring and milling. The shop is served by an 18 ft. span hand-operated traveling crane suspended from trolley beams on the lower chord of roof trusses, which crane travels over the above mentioned track running into the shop. In the southeast corner of the shop is located a small electrically driven air compressor furnishing air at 100 lbs. pressure for the operation of compressed air tools that so greatly facilitate repair work.

The blacksmith shop is housed by a separate concrete building about 22 ft. wide by 26 ft. long and 20 ft. high, which adjoins the shop building at the east end and from which there is an 8 ft. sliding door into the machine shop, as well as a similar door to the yard.

The walls of the shop building are practically a continuous belt of steel sash 10 ft. high around the four sides of the building, which gives excellent light and ventilation in the interior of the building.

The aforementioned 400 ft. dock, or wharf, was constructed of concrete in a most unusual and interesting manner. On account of the rock underlying the company's property sloping off at a grade of about 3/4″ per foot into and under the surface of Little Traverse Bay, the cost of dredging a slip was regarded as prohibitive and the alternative of building out into the bay sufficiently to secure the required depth of 23 ft. of water decided upon. The location being quite exposed, it was appreciated that a method of construction must be employed that would reduce the chances of damage to partially completed work by sudden storms to a minimum, and, as the company concluded to do the work with their own forces, the cost of the construction equipment necessary was also a material consideration.

After a consideration of several different methods of construction it was decided to construct the wharf of precast concrete blocks set in place by a large locomotive crane, as practically all of the equipment required would then be useful later in the construction of the mill or other works, and the precast blocks would be able to care for themselves in the event of storms.

Accordingly, a concrete casting floor about 20′ x 300′ was laid near the wharf site and several sets of carefully designed wooden forms made for casting blocks 15′ x 16′ in plan 4′ deep. These blocks were not solid, but cellular, the walls of the cells being 8″ thick and reinforced sufficiently to care for handling stresses. There were four cells to each block, each cell being about 6′ x 6′ in size, and the completed blocks weighed about 40,000 lbs. The making of the blocks preceded the actual start of the dock construction by about six weeks, and, as the blocks were made at an average rate of three daily, there were about 100 blocks in the curing yard at the time the water work was started. A Brown hoist locomotive crane[14] of 35 tons capacity was purchased for handling the blocks and with this crane the blocks, when six to eight days old, were lifted from the casting floor and stacked in the adjoining yard for curing.

Two small wooden scows were constructed, upon one of which was mounted a 4″ centrifugal sand pump and steam traction engine for driving, and upon the other a diver's outfit. A concreting trains consisting of three standard flat cars was made ready, the head car carrying a one-half yard mixer, a boom and hoist for handling a bucket; the second car carrying sand; and the third car, crushed stone.

The method of construction was as follows: starting from the shore, the diver cleaned the surface of the rock free of sand with the suction hose of the sand pump in exactly the same manner a carpet is cleaned by a suction sweeper. He then removed any loose rocks, those too heavy for hand lifting being handled by grapple hooks on the locomotive crane. One of the precast concrete blocks was then carried by the locomotive crane out to the dock site and lowered into the water, the diver leveling it with flat stones, as necessary, to compensate for the uneven surface of the bottom. The concreting train was then run out to the dock and a stiff 1-3-6 concrete lowered in a closed bucket into each of the cells of the block until the cells were filled to within about

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[14] Brown Hoisting Machinery Co., Cleveland, O.

12″ of the top. The concrete, of course, flowed into all the crevices and uneven surfaces of the rock bottom and anchored the block firmly to the lake bed, and made in effect a solid block of concrete 15′ x 16′ and about 4′ deep, upon which to rest further construction. After permitting the concrete to set about 24 hours, as many additional blocks were placed on the bottom block by the crane as were necessary to bring the construction above water line and the front cells of the blocks filled with concrete in the manner described above. The back cells were filled with 2½″ crushed stone. Upon the top block six 12 x 12 wooden stringers for the crane track were laid, and, proceeding out on this track, the crane set additional rows of blocks from day to day, the lake bottom being cleaned and the concreting done in the manner described above. It will be observed that, with this method of construction, nothing short of a very severe storm could harm work in place but not completed, on account of immense weight of the blocks, and that all equipment, in the event of a storm, could be pulled back into the yard, with the exception of the two small scows, which, after the completion of the first few rows of blocks, could be anchored in the lee of wharf and be well protected.

In the construction of the entire job but one row of four blocks and a few sections of track were lost due to storm, and this occurred at the end of the season when a most severe storm came up suddenly and prevented concreting. The bottom block was not disturbed even in this case, and work was resumed upon it the following spring. Of course, the top of the block wall followed the contour of the lake bottom and varied as much as two feet in places. Upon the top of the blocks a heavy concrete wall was constructed, making the final surface of the wharf wall uniformly seven feet above normal water line. This wall was protected from the wash of the sea by 3″ hemlock plank and two-12″ x 12″ hemlock fenders run the full length for the vessels to ride against.

The fill back of the wall was made of stripping from the quarry loaded by 70 ton steam shovel and hauled to the wharf site in 15 yard side dump cars. A minimum of 23′ of water is available the full length of the wharf, and, as the wharf has gone through two winters and shows no movement or strain as a result of the enormous pressure from the ice in the bay, the strength of the construction has been thoroughly proven.

The construction of the Petoskey works was carried out by the company's own forces under the direction of Vice-President and General Manager J. B. John, with E. C. Switzer, General Superintendent, in immediate charge of the work. The J. C. Buckbee Company, Enginners of Chicago, were in charge of all engineering work and furnished detailed plans for the entire project. A. B. Klise, of Petoskey, is president, and John L. A. Galster, of Petoskey, secretary and treasurer of the Petoskey Portland Cement Co.

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# Looking Back to the Days of the "Mud Floor"

## *The First Part of an Article*

By Charles W. Erdell

Bethlehem, Pa.

Today I want you to be my guest on a tour through one of the old cement mills, as they existed 25 years or more ago. I want you to forget present-day methods and revisit with me the scenes of the olden days, when the manufacture of portland cement was in its infancy. You will, possibly, feel like a Rip Van Winkle after our trip is completed, and will say to yourself: "Is this really the way we made cement before the advent of the revolving kiln?" I will recall to your memory things that happened then, which will bring home to you very keenly the great change that has been wrought in the industry since that time.

I will not tire you with a history of the discovery of the art of cement manufacture, neither will I burden you with any figures as to the production of cement in the year 1880, in 1900, or at the present time. The sole purpose of this article is to tell you in a clean, wholesome and interesting way the method that was employed up to the year 1900. We can truthfully say that, so far as America is concerned, the year 1900 practically witnessed the death of the "mud floor" way of producing cement, and ushered in the nearly universal use of the revolving kiln and powdered coal as fuel.

It seems hardly conceivable that any great manufacturing industry could undergo such a complete change in its methods as did the cement industry. Of course, when we now look back from maturity, so to speak, we can very well see that the old way was doomed to die, and, like all other industries, we had to keep abreast of the times and do things much quicker and on a larger scale. Experiments were made along the new line, and it was seen at an early stage that it was but a question of a short time when we would see the last of the old dome brick kilns, the mud-floor with its miles of hot steam pipes, and, worst of all, dust laden rafters and heavy timbers. In their place we now have, not the dense clouds of yellowish smoke and vapor issuing intermittently from the kilns, but the continuous gray smoke from the stacks of thousands of "roasters," as we boys called them at first. In the place of huge piles of coke, we now have great stocks of bituminous coal; and, instead of having a production of a few hundred tons a day, we have increased that production many times for that particular plant. So, taking it all in all, the change from the old to the new has been very thorough, indeed, and those of the younger generation of the business will no doubt sometimes wonder at the crude methods that were employed in those days. Suffice it to say that then each little mill had its own little world, and the cement people were a contented lot.

I remember a visit made to this country by a prominent English cement manufacturer many years ago, and he told me that when the change in method was taking place the British manufacturers could not understand why they should also change. They took the point of view that they discovered the art of portland cement manufacture, and could see no reason why they should not go on in the same way as always. However, they soon found that they were losing their foreign market, and, in order to retain what was left of it and to prevent, also, the importation of the article into their own island, they were compelled to invest millions of pounds in procuring new equipment. They saw, nearly too late, the handwriting on the wall.

If you would live over with me the days just before 1900, I ask you to go with me on a tour through the mill of one of Pennsylvania's first cement companies. The name of the little town would be instantly recognized were I to mention it, but for various reasons I prefer that it should remain unnamed. The incidents that I will recall will be quite in common with those of that period in nearly all other plants, and the reader can readily adjust himself to the particular mill where he had his early and strenuous training. As for the stranger accompanying us, he must be content with a recital of the happenings of those days, but he will get a clear enough understanding of the things that were done then and can compare them with the things that are being done today.

### THE QUARRY

After napping for 25 years, you will feel like old Rip Van and will, naturally, want a lot of fresh air. So we will visit, first of all, the quarry where the cement stone for the mills was obtained. So breathe in all the fresh air you can, as we will shortly enter the mill, that dark and dusty place, where one's lungs soon become filled with the dust-laden air.

As we approach the workings you may hear a certain hissing and thudding. No, that is not machine-gun fire, but it is the rat-a-tat-tat of the busy Ingersolls drilling into the rock. (What a change now exists, with our big well drills, gouging out enormous sized holes and to a very great depth!) See the men with sledge and bar, drilling holes into rock that has not been shattered by the last blast. These big rocks lie here and there, in the way of everybody, and so they must be disposed of promptly in order that the face of the quarry can be properly worked. See the heaps of "poor" stone; the old pipe; the broken-down dump carts; and the tired horses drawing their carts up and down the dark and dusty paths to and from the stone bins!

Do you see away up on the hill the men and beasts toiling away at the "stripping," which is the bane of the quarryman's life, as he can never tell how deep or shallow the earth on top of the rock may be? This work of stripping must be pushed relentlessly, in order that sufficient rock may be exposed for the drillers to work upon. It is very rough and uneven on the top of the quarry, where the stripping has been removed, so I hardly think that you will wish to climb the devious pathway that leads to the summit. But up there is where the head blaster sets up his battery, away back from the face of the cliff, and when he is ready to set off the charge, the watchmen are sent off in various directions to warn passersby and employees of the impending cataclysm. Whenever you hear their "Fi-re!" "Fi-re!" you can be sure that it will be followed by a deafening roar and the shattering of solid rock. When the blast is over, the scattered stone will be forked on to a pile and the busy carts will come back and the men will select the best stone, and we will follow the driver and horse and cart with their precious load of 1,600 lbs. raw rock to the mill.

### SAFETY FIRST

As we stumble along over the rough and rock-strewn ground we are forcibly reminded to "watch our step." We are now back in the age when "safety first" was just about beginning to don its swaddling clothes. So, in our travels through the mill, the absence of safeguards must go unnoticed, and we must not report to the management that here is something that is dangerous to life and limb, or, that there is something that might be looked after as a matter of safety. Neither do I want you to get the impression that the cement men of the early days did not appreciate safeguards, but rather do I want you to know that the class of men then employed in the mills were very intelligent and accidents were rare indeed. When we come to think of it, it is a remarkable fact that so few fatalities and severe injuries resulted from the inadequately protected plant as a whole.

### THE MILL

The mill, as you perceive, is built up against a bank, in order that the stone from the quarry may be dumped down to the basement, and that the coke may be brought in from the pile on to the second floor of the mill. The mill, as you will further notice, is constructed entirely of wood, and where the front portion of it rests upon the heavy upright timbers, it looks for all the world like a huge house on stilts. The roof, however, is made of corrugated galvanized iron, as the sparks from the lighted kilns require this precaution. You see, here and there, small openings in the sides of the mill, and those are the "windows." There are not too many of them and they are not too large, as all of the space along the inside walls of the building must be utilized for steam pipes and for the setting up of the bricks into "hacks." Also, there are only two doorways leading into the mill, and I guess we wouldn't have had these doors to let in God's pure, fresh air if it had not been for the fact that they were necessary to allow the coke to be brought on to the floor for the kilns. These doorway openings have heavy doors, mounted on rollers, but I am glad to say that they are never closed; no one takes the pains to try to close them, and if he did try he would meet with little success, as they never work properly and are usually off the roller track.

As we approach the doorway we see in the dusty interior the forms of men and boys, dimly outlined, busy at their work. We are not sure if they are black or white, as they are so begrimed with dirt and dust. This will remind us that we should don our dusters, or our suits of black and blue will be beautifully covered with a lading of such lovely cement dust that is now unknown. However, I, for my part, would much rather go through the mill dressed in the familiar overalls and jumper, in order that I can more intimately associate myself with every particular of the process.

Before we proceed, I will tell you of the layout of the upper floor, or "mud floor," where all the important preliminary work is done. The mill has sixteen kilns. Eight are located in the front portion of the mill and eight in the rear portion. They are so arranged that there are two rows in each part of the building. The two rows are parallel and the kilns are built as closely to each other as possible in order to conserve space and to keep the heat confined to one portion of the building. The kilns are built from the basement up, through the second floor and on up through the roof. They have their widest portion a little below the level of the mud floor, and taper inward, until they reach the roof, where it is seen that the diameter is much less than at the greatest point. For convenience the kilns have been numbered from 1 to 16. Now, after getting an idea of the arrangement of the kilns, it will be seen that the mud floors had to be constructed to meet the layout of the kilns. We have, therefore, a patchwork of floors here and there, and they are hemmed in by a multitudinous number of steam pipes.

Experience has shown that so many kilns in operation each day require so many square feet of floor space to take care of the needs of brick making. However, it has happened that enforced operations have required the necessity of constructing additional mud floors in order to meet the new demands. But, let us say that three kilns are in operation continuously. We will then know that just so much floor space is needed. We have laid out our floors accordingly. The distance from supporting post to post is called a "span." Therefore, each floor has so many spans, each span being of equal length (about 20 ft.). However, the floors are not of the same width, and we have cases where some floors are twice as wide as others, depending upon their location. The floors in the front and rear portions of the mill and adjacent to the kilns are the two largest floors. The floors are double boarded, the upper layer being made of surfaced white or yellow pine lumber, to permit of easy operation. Each floor is surrounded by banks of steam pipe of sufficient height to accommodate the brick from each particular floor. Of course, you will remember that we had a name for each mud floor, and I will name them for you. They are:

Oxen stall, containing 6 spans; Front, 6 spans; Mixer, 3 spans; Middle, 6 spans; Side (2), 6 spans; Canal, 5 spans; Stack, 1 span; Long, 6 spans; Rear, 6 spans; New, 2 spans; Indian, 6 spans; New Land, 9 spans.

You will wonder at the nomenclature of some of these floors. The "oxen stall" is so called because it is down below the usual floor level, is a dark hole and on the lower side there is hardly room for a man to stand up. The "front" and "rear" take their names from the location in those parts of the building. The "middle" and "side" floors lie side by side and are of equal dimensions. The "canal" is narrow and, no doubt, was termed thus because canals are narrow. The "long" is obvious from its name; the "stack" span was a short span, where the huge smoke-stack passes through the floor, and the "new" and "new land" derived their names from the fact that they were newly constructed. I never could find out why the one was called the "Indian" floor, so I will leave that to your imagination.

Before we go further on our journey, it remains for me to explain that the cement stone, after a preliminary crushing, is conveyed to the mill stones and there it is ground very fine. The "composition," as it is called, is then brought by elevator to the stock bin, which is located above and to the rear of the "mixer."

### The Mixer

We will now ascend the step to the mixer and see how our old friend Bob makes the "mud" that is used in making the bricks. You will notice that this particular part of the mill is very dusty; in fact, it is the worst place in the plant. This is caused by the composition rushing from the stock bin when the slide door is opened by the operator of the mixer, and coming in contact with the revolving mixer blades. As said before, the stock bin is located directly above the mixer, and when this bin is full of composition an enormous pressure is exerted against the small opening where it is allowed to flow into the mixer. Sometimes this opening cannot be closed promptly, after the mixer has received the required amount of composition, and the result is that the stuff soon fills the mixer to overflowing and spills out over the side and makes a bad mess of things generally. When this does happen, of course, the mixer "chokes," stops dead, the belt flies off the driving pulley, and things are at a standstill, until the surplus has been taken from the mixer.

It will be seen that the mixer is a simple arrangement, consisting of a rectangular trough, being 4 ft. wide, 7 ft. long and 3 ft. deep. The mixing blades are bolted to two shafts that are set lengthwise through the trough. The blades are so arranged, in staggered formation, that when the mixer is in operation the blades will just about pass each other. The water that is used is furnished by a pipe laid across the top of the trough. This pipe is perforated with many small holes on the under side, and throughout its entire length.

We will now let Bob mix a batch of mud for us. The clutch lever is moved into position with the driving pulley, and the mixer is in operation. You now see him pull at the rod that opens the slide at the stock bin, and the composition starts to flow into the mixer. He now also turns on the water, and as the mixer revolves the blades agitate the material very thoroughly. When it is seen that enough composition has been let into the mixer (if too much the mixer will "choke"), he stops the flow from the stock bin and gives his entire attention to watching the "mud" form. If the batch is too dry, he leaves the water on until it has reached the proper consistency. If it is too wet, he at once puts in more composition. However, as you notice, Bob has become so expert at this operation that it rarely happens that he gets a wrong mix. He now pulls a lever, which opens a slide in the bottom of the mixer, and the mass slides down a chute, where the mud-barrows are in waiting to receive their cargo, to be transported to the mud floors in various parts of the mill. I think the few minutes that we have spent up here will be enough for you, as I see that you feel a little uncomfortable in this "muddy" place. So, I guess we had better go below and follow the mud-barrow on its way.

Don't forget that Bob chews tobacco, not because he likes it, but because it is very necessary in his line of work, as it helps to counteract the effects of the dust that he is compelled to breathe, day in and day out. I have often stood watching him at his work, and well remember when something would go wrong with the mixer, or the belt, and the mud-barrows were down below waiting for mud, that Bob would answer their yells for "Mud!" "Mud!" by spitting viciously into the empty mixer and emitting ejaculations very common in those days. We will now say "goodby" to him. He is the mainstay of the business, but soon his art will have become a lost art, and he may some day be seen operating a "roaster."

### The Mud Wheeler

As we descend the steps there is a feeling of relief at getting away safely from this place. We will now step to the rear of the mixer and watch the mud-wheeler load his barrow with the soft, black, oozy stuff that was made a minute ago up above. Sometimes the mass clings to the chute and will not flow very readily into the barrow shown in Fig. 1. Hoes are then used to pull the mud down into the barrows. One mix makes about two barrows full, each weighing from 300 to 400 lbs. The mud-wheeler now pushes his load over the rough and uneven floors to the floor that has been cleaned, and where the crew of men and boys is in waiting. You see that these mud-wheelers, or mud-pushers, are men of strong physique. No others could stand up under this arduous work, as it is the hardest job in the whole plant. As he

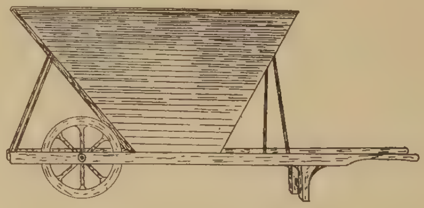

Fig. 1—Mud-Wheeler's Barrow

makes his way along the littered floor you can see the barrow lurch from side to side and it takes all of his strength to prevent the load from tipping over. He is taking the mud to the "rear" floor, and we will follow him there. The floor is entirely bare, so you will see the first load dumped on to the floor.

Here the "spreader" is in first charge of the mud after the mud-pusher has dumped it. The "spreader" is equipped with a long-handled, square point shovel, Fig. 2C, the end of which has been filed down to a thin cutting edge, which is nearly as sharp as a razor. He has also a strip of wood, about 1¼ in. square and 8 ft. long, which he lays on the floor to keep the mud from spreading unevenly. The spreader has already put this strip in position, and by its location the mud-pusher can see where the mud is desired to be deposited. When the pusher comes to within a few feet of the strip, he raises the barrow in the back and tilts it forward very quickly and deftly. When the barrow has reached a certain forward tilt, it raises the wheel off the floor and the barrow rests on a projection. At the same time the load of mud flows from the barrow and falls to the floor. Now the pusher's work is over for that trip. He takes the handles of the barrow into his arms and trundles back, in a happier frame of mind, for another load. Good-by, dear old mud-pusher! You were another link in the busy scenes of our life. How many of you "played out" on an extremely hot day! But not for long. Your days, too, are numbered, and, perhaps, we shall meet you again, hauling clinker in one of the newer mills.

### THE SPREADER

I have already told you of the sharp-edged shovel that is the only tool of the spreader. Before him lies the heap of mud. It is now his work to distribute that mud as evenly as possible over the surface of the floor. He takes his shovel and rests the handle on one leg, and with a strong forward movement he cleaves the pile of mud and deposits shovelfuls here and there, until it is very evenly distributed. The depth of the mud is the same as the strip of wood that lies along the side of the floor. When the spreader is finished, he pulls the stick along the hack and locates it for the next load of mud. This last movement on his part is a cue to the next person, and he is the "stamper" boy. I forgot to mention that "spreading" is a man's job, but sometimes young fellows that are able-bodied can handle the work. The spreader becomes very dexterous in his work, and it is the aim of all the youngsters on the floor to become full-fledged spreaders.

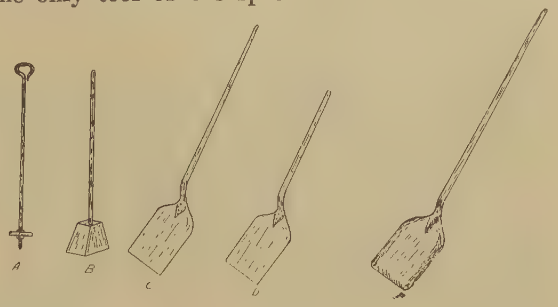

FIG. 2

# Cement Supply, American Expeditionary Forces

## *The Third of a Series of Articles*

BY EDWIN C. ECKEL[1]

As leases were made by Major Spackman, work was taken up at each of the mills leased, and under control of the Cement Section, E. P. O., cement manufacture by American troops was ultimately in progress at seven cement mills in France. The reasons for the selection of these particular mills, and the terms on which they were leased by the A. E. F. are matters which do not pertain to this story. They were determined by higher authority, and were accepted as "acts of God" by the company commanders who were charged with the troop organization and with the repair and operation of the different mills. Our part in the matter was simple enough; each company officer received a certain number of men, drawn at random from engineer draft replacement troops, and one or more cement mills, drawn equally at random and in varying conditions of repair or decay. Out of this collection he was to make first an organization that would hold together, and second, cement, or hydraulic lime, or whatever product his particular mill was capable of producing. Viewed from the latitude of Paris, the whole matter involved merely putting an order on paper; from the company standpoint it involved a good deal of actual work.

### THE LEASED AND CO-OPERATIVE MILLS

At the outset it may be noted that there were two entirely different methods in which the A. E. F. exercised control over its cement mills. In the case of three mills, they were actually leased from their French owners, and all the operations were carried out by A. E. F. troops under absolute control of the company commanders. The three mills thus controlled entirely and directly were located, respectively, at Mortagne-sur-Gironde, at Le Teil, and at Cruas. At these three leased mills all the operation and management of the mill, as well as police control of adjoining civil areas, was of necessity under the American officer in charge.

The officers in charge at the leased mills were:

Mortagne—Capt. E. C. Eckel (May); Lt. D. M. Cook (June to end, 1918).

Le Teil—Capt. Eckel (June to September); Capt. W. B. Sheddan (October to end, 1918).

Cruas—Lt. R. E. Le Kander (June, 1918, to October, 1918).

A cement pipe plant at La Frayolle, near Le Teil, was

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[1] Major, Engineers, U. S. R.

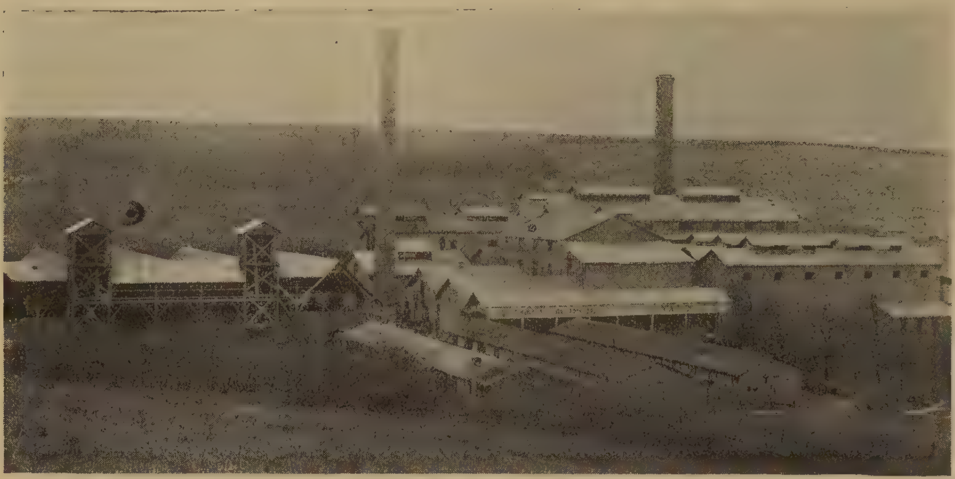


Fig. 1—General View of Portland Cement Plant at Mortagne-sur-Gironde Under A. E. F. Control. The Quarry Face is Seen in the Back-Ground at the Right of the Picture

Photo by U. S. Signal Corps

operated from August to October by another company, under Lt. Warner. Throughout the entire period the three companies on the Rhone—Le Teil, Cruas, and La Frayolle—were operated as a provisional battalion, which, from June to October, inclusive, was under command of Capt. Eckel, and during October and part of November, under command of Capt. Sheddan. In October the Cruas mill was given up, and in November the company making cement pipe at La Frayolle was moved to Brest and St. Nazaire.

In addition to the three mills above described, which were leased from the owners and entirely managed and operated by A. E. F., there were four mills to which coal and labor were supplied in return for delivery of a certain proportion of the product. These four mills, which for convenience may be termed the *co-operative mills,* were located as follows: Couvrot, near Vitry-le-Francois (Marne); Guerville, near Nantes (Seine-et-Oise); Beaumont (Seine-et-Oise), and La Souys, near Bordeaux (Gironde).

In the case of the four co-operative mills, A. E. F., Engineer troops, and in some cases civilian laborers employed by the A. E. F., were supplied as detachments of more or less size. These men were of course under charge of Engineer officers, but at the co-operative mills the American officers had no control over, or responsibility for, the technical operation or management of the mills.

The officers in charge of the co-operative mills were:

Couvrot—Lt. Howell.
Guerville—Lt. Lambert.
Beaumont—Lt. Roetter.
La Souys—Lt. Roeth.

The four mills here grouped were French mills, to which the A. E. F. supplied coal and labor, in return for a reduction in price of that portion of their output which was made by the use of such coal and labor. The co-operation, it should be noted, did not extend to the technical direction or control of the mills. Those were always entirely French; the American part was simply to supply a portion of the labor to work under French direction. The resulting conditions were therefore entirely unlike those at the three mills already discussed—Mortagne, Le Teil, and Cruas—which were entirely American, both in control and operation.

The arrangement under which cement was made for A. E. F. use at the four co-operative mills—i. e., La Souys, Couvrot, Beaumont, and Guerville—was defined as follows by Major Spackman, in a report dated September 16, 1918.

"The A. E. F. furnishes the coal necessary for the production of the quantity of cement alloted to them at each of these mills, which is in the ratio of one ton of coal for two tons of cement. In addition, A. E. F. furnished skilled and common labor for the operation of the mills, and officers for the supervision of the soldiers, inspection of the cement and general guarding of the interests of the A. E. F. The cement is paid for at prices fixed by the French government. These prices are fixed monthly and apply to all the mills in France. From the prices so billed is deducted the cost of the coal, price of which is fixed by the French government in the same manner as for cement, and the value of the labor furnished is charged against the French owners of mills at the same rate that similar work is paid for in the district, these prices again being controlled by the French government. The agreement further provides that in case the French government is unable to furnish the coal required in any one month to manufacture their allotment, that on furnishing the additional coal necessary te A. E. F. may utilize any productive capacity not in use."

### The Individual Mills

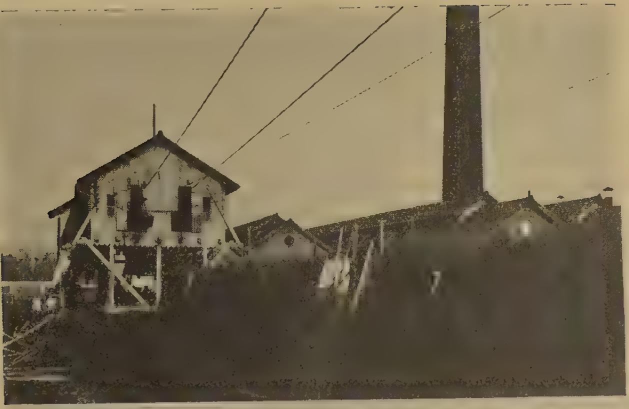
The distinction between our tenure in the two cases being clear, some notes regarding the individual mills may be given. For convenience these will be taken up in alphabetical order.

*Beaumont*—This mill is located at Beaumont-sur-Oise, about 25 miles north of Paris, and had both rail and water shipments. It was a mill completed immediately before the war, and was in excellent condition. The buildings were all of concrete, and the elevating and conveying machinery was of essentially modern type. It was equipped with two rotary kilns, 175 ft. long, giving an output of from 275 to 300 tons per day. Having a clinker storage of some 10,000 tons and a tank storage for finished cement of some 9,000 tons, it was able to carry itself through periods of shortage.

The raw materials used were chalk and clay. The chalk was quarried about 500 yds. from the mill, and was essentially pure lime carbonate. The clay pits were located some three miles from the mill, and the clay arrived by rail. The mixture was of course made by the wet method.

The detachment at Beaumont, called Cement Mill Co. No. 6, was at first commanded by Lt. Roetter; the first cement produced for A. E. F. use was on May 24, 1918. The total tonnage produced here for the American army was 9,900 tons. All of the product was a strictly high-grade portland cement.

*Couvrot*—This mill is located on the Marne River,



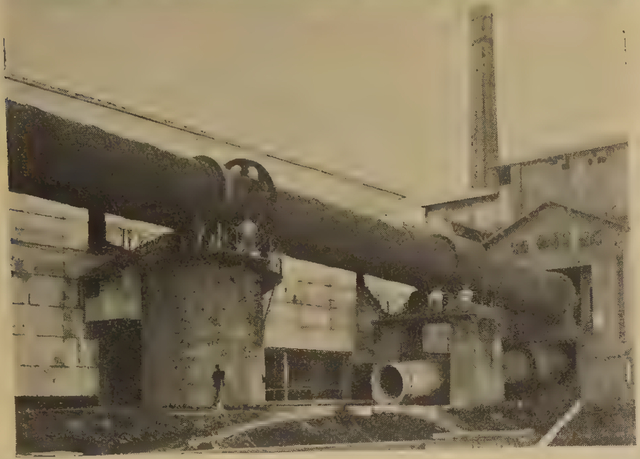


Fig. 2—Cable Way for Carrying Clay From Pits to Mill, About Half a Mile Away
Photo by U. S. Signal Corps

Fig. 3—Rotary Kiln at Beaumont Cement Plant
Photo by U. S. Signal Corps

about three miles west of Vitry-le-Francois, in the Department of Marne. It had facilities for both rail and water shipments, but it was located well within the army zone, and its operations were interrupted at intervals during the German advance of 1918.

The Couvrot mill had an output of something under 300 tons per day, made in two rotary kilns 150 ft. long. Its machinery was driven in part by shafting, but for some of the lighter units electric drive was used. It had a very large storage for ground raw material; a storage for 3,000 tons of coal, for 2,000 tons of clinker, and for 5,000 tons of finished cement.

Its raw materials were chalk and clay, mixed wet. The chalk quarry is located at the mill; the clay came by canal from pits some two miles from the mill.

Cement Mill Co. No. 4, located at Couvrot, was commanded by Lt. Howell. The first output of cement for the A. E. F. was on May 29, 1918; and the total made for American account was 19,353 tons, all of which was portland cement.

*Cruas*—The Cruas mill was located on the west bank of the Rhone, in the Department of Ardeche, about 100 miles south of Lyon. It was a plant producing hydraulic lime and grappier cement; equipped with vertical kilns, having a daily output of around 80 tons hydraulic lime and 15 tons of grappier cement.

The raw material used is an hydraulic or siliceous limestone, quarried at the mill. Cement Mill Co. No. 3, commanded by Lt. Le Kander, was located at Cruas. The first production here by American troops was on July 13, 1918, and the total quantity of hydraulic lime made for A. E. F. use was 1,823 tons. No grappier cement was made for American use during the time of our occupation, though cement of that type was largely employed on American work, being supplied through direct purchase by individual engineer officers.

*Guerville*—Located on the Seine, near Nantes, about 50 miles west of Paris, with both rail and water shipping facilities. It was equipped with two short rotaries—about 75-ft. kilns—and one newer rotary 175 ft. long. The total output per day was rated at 220 tons.

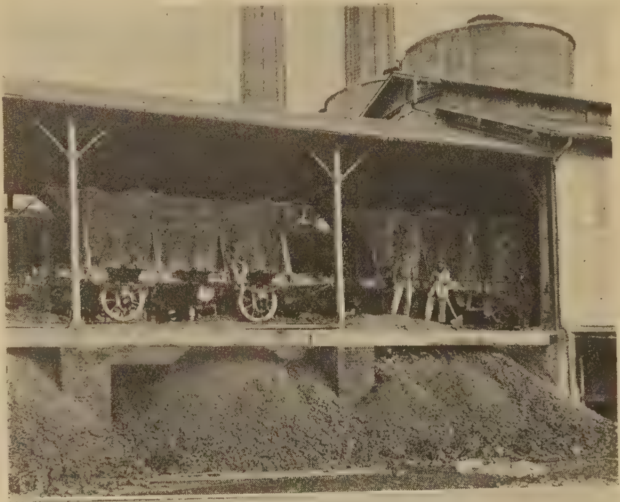
The raw materials used were chalk and clay, mixed wet. The chalk, quarried close to the mill, was brought in on a narrow-gauge railway; the clay came in by overhead cableway. The plant was of modern construction, and was electrically driven throughout, even to the loading cranes and the track locomotives.

Cement Mill Co. No. 7, located here, was commanded by Lt. Lambert. The first output of cement for A. E. F. account was on June 25, 1918; and the total made for American use was 7,826 tons.

*La Souys*—Located two miles above Bordeaux, on the Garonne, this mill had, like Guerville, two short kilns and one long one. Its capacity was of about the same, say 220 tons in actual running. The burning and grinding capacity would have been as high as 300 tons if there had been adequate provision for handling the raw material.

The raw materials used were chalk and clayey chalk, from the same series of rocks. The mixing and grinding was done wet, by wash mills and tube mills. The plant had a coal storage for 2,500 tons; clinker storage of 4,000 tons; and storage for finished cement of 2,000 tons.

Cement Mills Co. No. 5, commanded by Lt. Roeth,



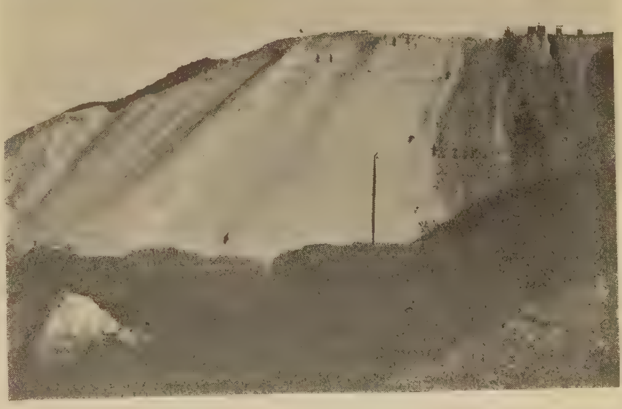


Fig. 4—Clay Storage at Beaumont Mill. The Clay Arrives by Rail From Pits Several Miles Away
Photo by U. S. Signal Corps

Fig. 5—Chalk Quarry at Guerville Mill
Photo by U. S. Signal Corps

was located at La Souys. The mill made its first cement for American use on May 24, 1918, and produced a total of 7,787 tons of portland cement for American account. Because of its location close to Bordeaux, it was particularly valuable, insuring an adequate supply of cement for the important A. E. F. work in that region.

*Le Teil*—This plant is located a few miles below Le Teil in Ardeche, on the west bank of the Rhone. It is the largest hydraulic lime plant in the world, and its output still finds use in the United States under the name of "Lime of Teil."

The plant was equipped with 26 vertical kilns, and could make around 175 tons of hydraulic lime and 20 tons of grappier cement daily. The siliceous limestone used as raw material is obtained from two sources, both located close to the plant. There is first a very large quarry, some three-quarters of a mile in length, and with a face 100 to 250 ft. high. Second, there is a mine, working underground a face about 20 ft. high.

The American troops at this point were commanded by Capt. Eckel from May until the end of September, 1918, after which they were in command of Capt. Sheddan. The Cruas company (No. 3) was always a part of this command. At Le Teil itself was stationed Co. No. 2 (Capt. Sheddan), while at La Frayolle, nearby, was stationed Co. No. 8 (Lt. Warner). The first output of hydraulic lime made by A. E. F. troops here was on July 10, 1918; the total output was 5,021 tons. No grappier cement was made for A. E. F. use at this point.

*Mortagne*—The mill, located at Mortagne-sur-Gironde, some fifty miles below Bordeaux, had nominally both rail and water shipments. But the railway was a narrow-gauge affair and the water was too shallow for large boats, so the transportation difficulties were rather serious. The mill was in very bad condition when taken over, and required extensive repairs.

The mill was equipped with two 90 ft. rotaries, having a nominal combined output of about 75 tons of clinker per day. The raw materials—two grades of chalky limestone—were obtained from a quarry near the mill, and mixed wet.

Cement Mill Co. No. 1, located here, was in command of Lt. Cook throughout, except for May, 1918, when Capt. Eckel was in charge. The first portland cement made here for our use was on July 17, 1918; the total made by A. E. F. troops amounted to 3,184 tons. It may be noted that Master Engineer C. D. Quick, assigned to this company, was the only trained chemist attached to any of the detachments.

### Notes on the French Cement Industry

There are certain general features of the French cement industry that may properly be noted here. In some cases they explain the difficulties encountered in our own work in France; in others they have a general trade bearing at the present day.

First of all, the cement industry of France is not concentrated ,but the product is made at a large number of small mills, widely scattered. This is due to several factors. The French population is very evenly distributed; freight rates are on a flat ton-mile basis; raw materials are found everywhere; and, most important, the French coal supply, instead of coming from one or two areas, is mined in some 60 different fields, most of them very small. All these factors work together against geographic concentration of any industry in France. What we do find there is a certain degree of concentration of ownership—one firm or company will control half a dozen mills, but they are all apt to be small, and widely separated geographically. The *average* mill is probably not over 1,000 bbls. per day; certainly less than 2,000 barrels.

Second in point of interest is the wide variety of products made. Instead of making only portland cement, practically every company makes two or three cements: portland, natural, hydraulic lime. This, too, is a matter of coal supply and of careful engineering economy. A French engineer will not use portland cement for any purpose where a cheaper cement will do the work just as well; and we must admit, after experience with the French products, that for very many uses hydraulic lime and grappier cement are not only as good, but are better than portland cement. Also, in a country poor in coal, this is very important; they cost about half as much to make, because of their lower fuel requirements.

As regards the portland cement mills, there are certain features that are quite widespread. Among these we may note that they are almost all wet-process mills, and on French coals and raw materials this gives very fair economy and superior cement. Then they are equipped with very well made machinery, but as a counterbalance, while it is more carefully made than American or German, it is very hard to repair. Standardization does not exist in French machinery; every engine seems to be built to order, and so it is hard to get spare or repair parts in a hurry. Another feature of the plants is the heavy clinker storage and the relatively small storage allowed for finished cement. This is due to the fact that the prevalently damp climate of northern and western France causes rapid deterioration in finished cement.

In French cement mills, as in other French industries, the pay is low and the range in wages is very small, as between occupations. Up to 1915, the pay ranged only from 14 cents an hour for common labor up to 17 or 18 cents an hour for the very highest paid men in the mills. A little later raises of 12½% to 15% were made throughout France, to cover a part of the rising cost of living.

As regards labor, the pay scale is very low indeed, but on the other hand the employers carry on an immense amount of benefit and welfare work, some of it voluntary, but much of it forced by the state. These features should be added to the regular pay, in order to put matters on any comparative basis. The labor is of excellent quality; the French mill or quarry worker will labor just as hard as an Italian, and he is far more intelligent. But he will spread his ten or twelve hours of work over a much longer period, because he *will* have rest and meal periods at numerous intervals. If you accept this fact and arrange your working forces accordingly, you will get good results; but if you try to eliminate one or more of the extra breakfasts or lunches, you will never get anywhere. And there is another matter that anyone starting work in France will do well to keep in mind: handling French workmen, like handling French soldiers, is a good deal of a personal affair, and a successful French mill, like a French regiment, has a family atmosphere about it that is strange to other nationalities.

So far as export trade is concerned, the normally high cost of coal in France will serve to prevent any serious shipments of French portland cement, except perhaps to Argentina and Brazil, where they go as return cargoes. But with regard to hydraulic lime and grappier cement, this limitation does not exist; and under the spur of commercial necessity, I look to see something done in the way of exports of these products, which are economical in fuel costs.

# Portland Cement Output in Oct. and Nov.

There were appreciable increases in both production and shipments of portland cement in October, 1921, notwithstanding the seasonal trend. The production exceeded that of October, 1920, and according to available statistics was the largest ever recorded for a single month. The production for the first ten months of 1921 was greater than the production during the corresponding period of 1920 and about 10.5% in excess of the average for the same period during the five years 1917-1921.

The shipments for October exceeded the production and established a record. The shipments during the ten months ending October 31 exceeded those during the corresponding period of 1920 by about 1.5%, and exceeded the average for the same period during the five years 1917-1921 by over 11.3%.

Stocks of finished cement at the mills at the end of October were approximately 5,348,000 bbls., compared with 6,953,000 bbls. at the beginning of the month and with the average of about 6,014,000 bbls. for October during the last five years.

The production of clinker, or unground cement, in October was approximately 9,891,000 bbls. Clinker production for the ten months amounted to approximately 82,419,000 bbls.

### November Production

The production of portland cement continued on a large scale during November, approximately 8,921,000 bbls. of finished cement having been manufactured. This quantity represents a decrease of 1,585,000 bbls. as compared with the record production of October, 1921, but is larger than that for any other month of this year up to May and is about 17% greater than the average for November, 1917-1921. The total production for the eleven months ending November 30, or 91,734,000 bbls., was about 99.5% of the record quantity made during the corresponding period of 1920, and was 11% greater than the average for the first eleven months of the years 1917-1921. Favorable operating conditions are indicated by this large production, the decrease having been due mainly to the slowing up of orders during the month.

The shipments of portland cement in November showed a marked falling off as compared with those during the warmer months of 1921, but were about 82% of the average for November, 1917-1921. The total shipments for the first eleven months of 1921, approximately 91,354,000 bbls., were nearly 99% of the record shipments during the corresponding period of 1920 and were about 9% greater than the average of those of the corresponding eleven months in 1917-1921. The reduction in shipments probably is due in part to decreased demand attendant upon the advent of cooler weather, and possibly demand has been to some extent held in check as a result of continued rumors of the possibility of reductions in freight rates. Normally, however, a seasonal reduction was to be expected, although, perhaps, not so abrupt as the curve shows.

Stocks of finished portland cement at mills on November 30 of about 9,091,000 bbls. showed an increase consistent with the sustained production and reduced shipments during November, and were about 25% greater than the average for November, 1917-1921.

The statistics prepared under the direction of Ernest F. Burchard, of the United States Geological Survey, are based mainly on reports from producers of portland cement and in part on estimates. They indicate that even though the output for December should not quite equal that for November, the totals for 1921 would come very close to those for 1920 and thus constitute one of the highest outputs on record.

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# Cement Association Bases Membership on Quality of Product

At the final session of the Annual Meeting of the Portland Cement Association, which was held in December at the Biltmore Hotel, New York, the Association's Constitution and By-Laws were amended so as to make membership in the Association "Contingent upon member's product meeting the Standard Specifications for portland cement adopted by the United States government and the American Society for Testing Materials."

Engineers, architects and contractors are familiar with the high standard of specifications governing cement manufacture, and will herald this action as the greatest advance step ever taken by the industry.

Along with other scientific-educational-research activities, the Portland Cement Association is distinguished for its co-operative work with technical societies. This has been in the nature of contributing to the improvement of building materials, methods and standards in general, among these being building codes, but the Association has particularly been active in keeping standard requirements for portland cement on a high plane and in insuring its proper use by the consuming public.

The Association is not concerned with the commerial relations of its members to their patrons and while not undertaking to guarantee directly the quality of cement produced by its members, has very adroitly accomplished the same thing by adding to its constitution and by-laws the amendment above mentioned.

This action of the Portland Cement Association perhaps typifies its service to the public in a way that will be more readily grasped by people at large than any other one item of practice or policy under which it operates. President L. T. Sunderland, of Kansas City, Mo., who was re-elected at the annual meeting, in commenting upon this amendment, says:

> This only serves as a further protection to the cement buying public. Portland cement always has been a highly standardized product, but as varying degrees of skill have been displayed in so-called tests of cement made by people not thoroughly grounded in testing practice through lack of long and competent laboratory training, misleading results have often been announced. The public can now feel assured that if the cement is produced by a member of the Portland Cement Association, that fact is an added endorsement of quality and actual assurance that it will measure up to the accepted engineering standards, since otherwise membership in the Association would be thereby jeopardized.

Re-elected with President Sunderland were Richard Hardy, first vice-president, Chattanooga, Tenn.; S. B. Newberry, second vice-president, 818 Engineers Building, Cleveland, Ohio; and F. W. Kelley, treasurer, 126 State street, Albany, N. Y.

The following directors were also elected: H. Struckmann, 342 Madison avenue, New York City; Charles F. Conn, 603 Pennsylvania Building, Philadelphia; H. L. Block, Post Dispatch Building, St. Louis, Mo.; W. M. Hatch, Union City, Mich.; George T. Cameron, Crocker Building, San Francisco, Cal.; and David M. Kirk, Wampum, Pa.

# Men and Mills

## *Notes from the Field*

The possibility of Bessemer Limestone & Cement Co. being invited to enter the proposed independent steel merger has been suggested in responsible quarters, it is reported. Cement and limestone, the latter in the form of blast furnace flux, are prime essentials in iron and steel making. Bessemer has a reserve of more than 60,000,000 tons of limestone and a cement plant with an annual capacity of more than 1,000,000 barrels. It is regarded as a logical unit to round out a big steel corporation.

Cement in New York City was 10 cents a barrel lower in price and maple flooring from $5 to $10 a thousand feet higher on Dec. 8 than that of the previous week. Cement price reductions were ascribed to two causes. One reason given for the slump is to the effect that once more efforts are under way to make New York a Hudson River price basis market. The other is to meet the recent underselling policies of certain companies with a vigorous price war, even though the present price of $2.80 per barrel delivered, leaves some of the mills a margin of only a few cents over and above actual manufacturing cost.

W. J. O'Connell, superintendent of the Superior Portland Cement Co., was elected mayor of Concrete, Wash., at the annual election on Dec. 6.

Plans are being formulated for establishing a cement plant near Gore, Georgia. A company is being organized and the reported plans include a plant to manufacture 3,000 barrels of portland cement per day.

According to the reports of the U. S. Geological Survey, the location selected contains enough limestone to keep the proposed plant in operation for 20 years. There is a large tonnage of shale available about 16 miles from Gore.

A. F. Krabbe, manager of the Olympic Portland Cement Co., and his wife of Bellingham, Wash., were scheduled to sail from New York, via the Scandinavian American liner, Frederick VIII, January 3.

Mr. and Mrs. Krabbe will make a tour of Europe, including a visit to Mr. Krabbe's old home in Denmark. They will visit relatives in Norway, Switzerland, France, and England, planning also to visit Italy.

They expect to be gone on this trip about three months. Mr. Krabbe will make a study of business conditions in the different countries that he visits.

The Superior Portland Cement Co. shipped 75,000 barrels of cement in October and 41,000 barrels in November, which is very satisfactory for that season of the year. Shipments were still holding up well at the end of the year, with indications that the plant will start up in 1922 considerably earlier than usual.

The International Cement Corp. has started construction work on a one-story storehouse at the mill of the former Knickerbocker Cement Co. in the vicinity of Hudson, New York. According to a local report the contract for the storehouse which it is estimated will cost about $200,000 has been awarded to the Turner Construction Co., New York City.

There is no prospect of the plant of the Wolverine Portland Cement Co. at Quincy being opened during the present season. The plant has been closed for over a year. The Coldwater plant of the Wolverine company is working at full capacity and is employing many of the former Quincy men. It is expected that the Coldwater plant will run until the operation of the marl beds is stopped by freezing weather. When this occurs the plant will receive the customary overhauling.

The tug that hauls the marl scows on the lake at the Wolverine plant got stranded during a heavy fog one night recently and the men were kept on the tug most of the night before they were located by parties on land who had been attracted by the blast of the whistle.

The Bessemer Limestone & Cement Co. is operating its big cement plant to capacity accumulating against the big spring buying. It has capacity for storing 500,000 barrels of semi-finished material.

About 50 men are at work for the Hudson Valley Cement Co. at Alsen, N. Y., which recently reorganized the Alsen Co. It is reported that operations will be resumed at this plant early in the spring.

The Egyptian Portland Cement Co., of Fenton, Mich., has had a highly successful season, under the management of Edward R. Sullivan, for many years connected with the Peerless Portland Cement Co., of Union City. Although the Egyptian company has only comparatively limited storage capacity, shipments have been so regular all season that there has been no necessity for discontinuing manufacturing. The Union City and Fenton plants are closely connected as to capital and management, and Chas. Smith, who is superintendent of both plants, visits each factory nearly every week.

The factory of the Peerless Portland Cement Co., of Union City, was still running full force late in December, and will continue to do so until the opening of the new year, at least. It has been a highly successful season, with the factory in full operation for ten months. More than 400,000 barrels of cement have been manufactured, and it is a remarkable fact that the big storage bins of the company have very little cement stored therein. This is a very unusual condition, as they are generally well filled up at this time of year. The first of August the company had 100,000 barrels of seasoned cement on hand, but orders came pouring in at that time and there has been continuous shipment ever since. The plant will be shut down during January and February for the annual repairs and the installation of new machinery.

During the past year nearly all of the Alabama cement mills have operated on capacity time. And there has been a demand in the south for all the cement they have turned out. From present indications the south, for the next few years at least, will see the most prosperous building period ever known.

The Atlas Portland Cement Co. at Leeds, the National Cement Co. at Ragland, and the Gulf States Cement Co. at Demopolis, operate the main cement plants of Alabama. All of these have been operating on capacity time for the past year, according to local reports.

At the present time, besides being used in Birmingham and points in Alabama, cement made in Alabama is being shipped to various places in Georgia, Florida, North Carolina, South Carolina, Mississippi, Tennessee, and Louisiana.

In the raw mill of the Texas Portland Cement Co., at Dallas, Tex., the company has added one No. 85 F. L. Smidth wet kominuter, one 5 x 22 tube mill and four new reinforced concrete agitating storage basins, 1,000 bbls. each, have been installed. Four old 8 x 125 ft. kilns have been dismantled and replaced with three kilns, 9 x 8 ft. in diameter by 220 ft. long, with three concrete stacks and three new coolers. Steel and concrete have been used throughout the construction.

The third kiln was started operating the first of December, and the Dallas plant is now showing a full capacity of 3,000 bbls. per day.

The Northwestern States Portland Cement plant, which had been releasing men, closed down late in December for an indeterminate period, according to officials.

Of the 500 men usually employed in the plant 250 remain on the job in the repair and construction departments. The plant will resume operations as soon as the year's repair work is completed, it is hoped.

At the annual meeting of the stockholders of the Northwestern States Portland Cement Co., held in the company offices in the First National bank building, C. H. McNider was re-elected president. The regulation dividend was paid and officers and directors were elected the same as last year. A. F. Frudden was chosen vice-president; F. G. Ray, secretary, and F. H. Keeler, treasurer. Other directors chosen were Hanford McNider; W. H. L. McCourtie, F. H. Winsmore, M. T. Gunderson, S. L. Wright and W. O. Winston. It was the unanimous sentiment of the directors that 1921 had been a good year for the cement concern.

Investigations are under way to determine the suitability of rock deposits near Alliance, Neb., for the manufacture of portland cement. R. M. Hampton, mayor and president of the First National Bank, is interested in the project. According to a report from Alliance, in case it is decided to build a cement plant in that locality, a large part of the machinery now in the defunct potash plant at Antioch will be used, since this can be installed at a much less cost than new machinery.

November 3 last Charles R. Leo, formerly the general manager of the Palmer Lime & Cement Co. was elected to the position of vice-president, taking the place of Carleton H. Palmer, resigned, and C. G. King, former superintendent of the company's plant at York, Pa., was elected to the position of general manager.

Frank M. Rudd for several years president of the Wolverine Portland Cement Co., at Coldwater, Mich., but recently a resident of Baltimore, Md., died at the Johns Hopkins hospital in that city, November 21, 1921, aged 60 years. Mr. Rudd was succeeded as president of the cement company a couple of years ago by C. C. Jones, of Coldwater, Mich.

Mr. and Mrs. G. S. Brown, of College Hill, Easton, Pa., celebrated the twenty-fifth anniversary of their wedding by entertaining friends at their home. Mr. Brown is president of the Alpha Portland Cement Co.

The Huron Portland Cement plant at Alpena, is operating full capacity, with no indication of a let up in the immediate future. Winter shipments will be by rail. Last January the plant closed for extensive repairs, but this year workmen anticipate a straight run through the winter. The reserve supply was exhausted during the summer and the opportunity to replenish it did not arrive until lake traffic ceased. It is presumed that months will be required to accumulate a normal supply.

Construction in connection with the enlargement of the plant has been under way for two months and is still being pushed.

The West Coplay mill of the Lehigh Portland Cement Co. was shut down December 1, and no date was announced for the resumption of work.

The Lehigh mills in Mason City, Ia., closed operations on Dec. 1 for an indefinite period to make repairs. Approximately 500 men had been employed up to that time. Only a hundred are working on the repairs. How long the cement manufacture will be suspended has not been decided, officials at the plant state.

According to the present plans of the National Portland Cement Co., work will be started on the erecting of the company's new plant at Coldwater Lake, near Mt. Pleasant, early in the spring. The company maintains an office in Detroit under the charge of H. C. Shields, general manager.

The work has been started by the Security Cement and Lime Company, Hagerstown, Md., erecting a new battery of silo storage bins. The work will be rushed to completion as soon as possible.

The Colorado Portland Cement Co. has just purchased a new 20-ton Link Belt locomotive crane for handling coal and doing general work around the plant.

Eighty-three piles have been driven and planked along the bank of the Arkansas River to bring the water to the pump. Two new loading sheds have been added to the packing house.

The Steamer Scranton left the Alpena plant of the Huron Portland Cement Co., on her last trip for the season, Dec. 2nd, with cement for Duluth.

The Steamer Mitchell, the bulk cement carrier, made her last trip of the season bound for Detroit, Dec. 11th.

During the month the Cottrell dust system was put in commission by the Huron company. At first there was a slight interference with the government radio station but the trouble was soon overcome by carrying out suggestions made by an ex-radio man who was in the employment of the cement company. Credit has been wrongly given to the men of the radio station through some of the papers, but they had nothing to do with the matter except to report their finding at the station while the work was being carried out. It was found that they were carrying a wave length of 600 meters and by reducing the wave length produced in the Cottrell system below 300 meters there would be no further trouble.

The Beaver Portland Cement Co. is installing a 15-ton locomotive hoist at its plant at Gold Hill, Oregon. Additional equipment will include a 50-ton capacity crane and 1-yd. capacity clam shell buckets. The main object in adding this equipment to the plant is to avert possible delay in operating the mills and furnaces of the factory in case of a shortage of limestone from the quarries due to shortage of help or accident.

This equipment will also be used in handling clinker and gypsum, which is shipped to the plant and dumped on the trackway. This new equipment will permit the company to resume operations at the Zacker quarry, two miles below the factory, pending resumption of work at the main plant, which is being extensively overhauled after a two-year steady run.

John Somaldy, aged 35 years, a foreman at the plant of the Atlantic Potash Co., formerly the Northampton Cement Co., at Stockertown, was instantly killed when he fell from a truss, while engaged in loading machinery, and landed head-first on the concrete floor, 25 ft. below.

The Ajax Transportation Co., which has been operating trucks for some time carrying cement between Bath, Pa., and West Portal, N. J., has ended its season's activities after helping to furnish employment for a number of men by keeping the cement plant operating.

W. E. Gardner has been appointed sales manager of the Security Cement and Lime Co., to fill the vacancy caused by the death of H. B. Warner.

Both Martin Creek plants of the Alpha Portland Cement Co. have resumed operations after a shut-down for several weeks. Prospects are reported bright for work all winter.

The Olympic Portland Cement Co. expected to close its plant about Christmas for an indefinite period, after a production of approximately 450,000 bbls. for 1921. For some time it has been running at half capacity on account of a decline in demand, due mainly to the completion of the road program in Washington for the year. The bulk of its output was used in road construction in the state of Washington. The company made no foreign shipments this year, but it did ship some cement to Honolulu. It seems likely that the demand for cement next year will be good, as there is a probability that long stretches of concrete pavement will be laid in 1922. There also are prospects for considerable building.

During its shut-down the Bellingham plant will make its usual annual repairs. These will require several weeks to complete. The company is uncertain when it will resume operation in 1922.

It is uncertain when the plant of the Superior Portland Cement Co., at Concrete, will resume operation next season. It has had a busy year, and has produced about double the Bellingham factory's output. Its daily capacity also is double that of the Bellingham plant, or 4,000 bbls. This plant also will devote some time to repairs.

All forces employed in the plant of the Dixie Portland Cement Co. located at Richard City were laid off and work discontinued December 23, according to a local report. The shut-down will not be for more than thirty days, it is believed. However, no definite date of reopening the plant was announced.

The shut-down is due to over-production. It is claimed that the storage capacity of the company's warehouse has been reached, and that operation will not be resumed until a large amount of stocks now on hand are disposed of.

Richard Hardy, president of the company, in commenting on general conditions in New York and New England, declared that in his opinion, with the adjustment of freight rates, and other problems confronting the manufacturer, now under way, normalcy would be restored.

Manager W. M. Hatch, who is also secretary and treasurer of the Peerless Portland Cement Co., Union City, Mich., has recently sold his residence in Union City and removed to Battle Creek, where he has purchased a new home. Mr. Hatch, however, visits the factory each day, making the forty-mile round trip by automobile.

Nicanor Garcia y Lastres, general manager of the Peruvian Portland Cement Co., Lima, Peru, was in New York in December in the interests of his company.

Mr. Lastres reported that his company's plant is running very successfully, but that a larger output is sought to offset competition from Germany. He reported that German cement has already driven American cement from the Peruvian market, because of lower price. Foreign cement delivered there deteriorates badly in transit, and there is much loss from breakage of barrels, etc.

Mr. Lastres will visit Canada and possibly England before returning to his home.

The Bucyrus Co., South Milwaukee, Wis., has announced the removal of its New York office to Suite 728, 30 Church street, with E. G. Lewis in charge as Eastern sales manager, effective December 1.

Preliminary negotiations have been started with a view to establishing a new cement plant near Portersville, Cal., where suitable raw material has been found for the manufacture of portland cement. After negotiations are closed plans will be worked out by the Hunt Engineering Co., Kansas City, Mo.

E. L. Davis, formerly plant superintendent of the Crescent Portland Cement Co., at Wampum, Lawrence County, Pa., is now located in Racine, Wis., and is connected with the Blandin Phonograph Co., of which he is mechanical engineer.

The main sales office of the Vulcanite Portland Cement Co. is now located at 350 Madison avenue, corner of 45th street, New York City.

The cement plant of the Beaver Portland Cement Co., at Gold Hill, Ore., which has operated steadily for the last two years, has closed down for a season of general repairs. It has come at a time while orders have slacked down, permitting the filling of the storage warehouse sufficiently to supply orders for several months before resuming. During the period of the closing of the mills and furnaces, operations will continue in a small way in the quarries in getting out limestone for future operation of the plants. This will require extensive equipment to be added to handle the rock after being dumped at the plant.

Contractor James F. McDermott and a force of men from Allentown, recently removed two 40-ton engines and a 15-ton Heine boiler from the Phoenix cement plant, Nazareth. The plant is now entirely electrically operated, power coming from the Hauto plant.

The new office building of the Glens Falls Portland Cement Co., at Glens Falls, N. Y., is now complete and is being occupied by the company. The building is one story and basement high, and contains the laboratory and the general offices. Wherever possible the company used its own products in constructing the building.

The name of the Mitchell Lime Co., located at Mitchell, Ind., has been changed to the Lehigh Lime Co. The lime company has been operated for a number of years as a subsidiary of the Lehigh Portland Cement Co., and the change of name has been made to indicate the relationship between the lime company and cement company.

Thomas L. Dates has resigned as works manager of the National Portland Cement Co., effective Jan. 1, 1922.

The Acme Cement Corp., Catskill, N. Y., has closed down most of its plant for repairs. Clinker grinding is being continued. Complete operation will be started in the spring.

The Hudson plant of the Alpha Portland Cement Co. is closed down for repairs and improvements, including a new tramway. It is intended to have the improvements completed in time for early resumption of operations in the coming season.

The Alpha Portland Cement Co., on behalf of its plant at Martin's Creek, Pa., filed a petition with the Interstate Commerce Commission, asking that the Pennsylvania R. R. be required to establish reasonable rates in lieu of the rates now in effect for cement in carload lots from Martin's Creek to points in New Jersey between Riegellsville and Stelton both inclusive. The present rates are declared unreasonable and unjustly discriminatory and in violation of the long and short haul provision of the Interstate Commerce Act.

The Dewey Portland Cement Co. has awarded the contract for the construction of a battery of four additional silo storage tanks for storing cement. The contract was let to the Macdonald Engineering Co., Chicago, according to a local report. This company has had wide and successful experience in the construction of deep bin storage systems.

A very disastrous fire occurred in the Louisville Cement Co. plant at Speeds, Ind., on November 22. The fire was discovered about 10 o'clock in the evening in the Brixment packing house, and it had already gained such headway that it was impossible to save the building.

Twenty-six thousand barrels of Brixment had been stored in the building which burned, and after the fire had burned itself out this Brixment lay exposed to the weather. A rain on the Brixment would have increased the damage already done by the water thrown on the burning building. A large tent 200 ft. by 100 ft. was sent from Louisville to Speeds on the company's warehouse truck. The work of putting up this tent over the hot Brixment started in the afternoon and lasted late into the evening. It was spread over the pile just in time to protect it from the rain which began to fall, and working in the storm the men succeeded in fixing the tent that same night.

Six new kilns are being constructed at the plant of the Scioto Lime & Stone Co., Delaware, O. A new underground conveyor for handling the burned lime is being installed. It will handle the lime from the cooling pits to an elevator leading to the overhead bins which feed the hydrators.

The Bonner Portland Cement Company's plant closed December 15. It will re-open January 10. Practically all of the employees are working on repair work. All of the bins are empty and when opened the plant will be run with a full force.

Chris Goll, head chemist at the Bonner Portland Cement plant attended the convention of the Portland Cement Association in New York. While in the east he visited his mother at Hoboken, N. J.

W. H. Frederick, for 14 years quarry foreman at the Bonner portland cement plant, has resigned and opened a general store in Bonner Springs, Kans.

John Dean, 67 years old, who has been employed in the mills of the Bonner portland cement plant for ten years, died December 15th.

It was the intention of the Nazareth Cement Co. to close its plant late in December to make needed repairs.

Ralph Law, secretary of the Signal Mountain Portland Cement Co., anticipates that actual construction work will begin shortly after the first of the year. The entire plant when completed will cover several acres of ground, and, it is claimed, will be the most up-to-date and the most complete cement plant in the south.

That the supply of natural gas recently struck on the Siveley farm by the Dryden Development Co. will be contracted for, if a sufficient quantity is obtained, is hinted by officers of the cement company. It was stated that if natural gas can be procured in sufficient quantities to operate a cement mill the cost of production will be cut more than 40 cents a barrel. The heavy costs in the production of cement are labor and fuel.

Work on the extension of the trolley line from Red Bank to a point near Daisy is expected to be started within thirty days. If the gas supply does not prove to be of value the supply of coal, it is anticipated, will be brought over this line from the Daisy district.

Guy Bowser is now works manager of the Hanover Portland Cement Co., Ltd., Hanover, Ont.

R. J. Kellogg has succeeded E. M. Confer as superintendent of the Gulf States Portland Cement Co., at Demopolis, Ala. Mr. Confer is now manager of the O'Neal Lime Works at Calera, Ala.

Stockholders of the Bessemer Limestone & Cement Co. at a special meeting approved the directors' recommendation that $750,000 of 8% sinking fund, convertible gold notes be issued.

Proceeds of the notes, issued under date of Jan. 1, will be used to defray new construction expenses and provide some additional working capital.

The underwriters will offer common stockholders the privilege of participating in the underwriting to the extent of two-thirds of the issue of $500,000. As there is $1,500,000 of outstanding common stock, each holder of such shares will have the privilege of subscribing for the notes to the extent of one-third the amount of his or her common stock holdings.

## Aetna Company to Build New Plant

A site has been purchased near Bay City, Mich., and plans are being formulated in the eastern office of the Aetna Portland Cement Co. for a new cement plant to cost approximately $1,000,000. According to Oscar J. Lingemann, general manager, definite plans have not been decided upon, and the time for starting construction work is still indefinite.

The newly acquired site is located on the Saginaw river, at Essexville, a suburb of Bay City. Dredging in the river to establish water shipping facilities will probably be included in the preliminary work.

# Value of the Brand in Portland Cement Industry[1]

In the latter half of the nineteenth century, the distinctions between the various brands of portland cement were more marked than they are in these days of standard specifications, and the practice of specifying certain brands was somewhat widely adopted by engineers and architects.

There were good reasons for this practice, because the manufacture of cement was practically in its infancy and the differences in quality between one brand and another were appreciable.

The reputations for reliable quality established by certain manufacturers last century are still effective at the present day, and, on the other hand, the prejudice against cement made in certain districts—arising from attempts to produce cement with inadequate plant—has not yet died out, although there now remains no justification whatever for such prejudice.

It is undeniable, however, that strong preferences and strong antipathies in connection with certain brands of portland cement still exist, and a consideration of the causes for these may be enlightening.

It may be taken for granted that all portland cement produced in this country complies with the British Standard Specification, and the popularity enjoyed by some brands of cement must be due either to superlative quality as judged by British Standard Specification tests, or to some other cause not revealed by such tests.

Firstly, with regard to the standard tests, it is evident that the quality appealing to users would be tensile strength above the average, resulting in a correspondingly stronger concrete. Fineness of grinding has no intrinsic value in itself, but is merely a means of obtaining additional strength, although to a contractor who buys cement by weight and uses it by measure, the extra bulk of finely ground cement is an attraction from a commercial standpoint. A cement, therefore, that consistently shows tensile strengths of 800 lbs. when neat and 350 lbs. when mixed with three parts of sand and tested at seven days, would certainly be preferred to one that yielded say 00 lbs. and 220 lbs., respectively, under the same conditions. Hence, the cement manufacturer has one very obvious method of improving the reputation of his brand by improving his tensile tests. By what means this can be done is not within the scope of this article to discuss.

Specification tests do not, however, reveal the secret of the popularity enjoyed by some brands, because the popularity depends upon the faculty of rapid hardening, and it should here be explained that quick setting and rapid hardening are terms which, when used in connection with portland cement, have different meanings.

A "quick-setting" cement is one which reaches a certain arbitrary standard of consistency in less than 30 minutes, and the term has no reference whatever to the hardness attained in 12 or 42 hours. The term "rapid hardening" refers to the behavior of the cement in the period immediately following the final set.

It is not uncommon to find that a cement with a final set of four hours is harder at 24 hours than one with a final set of 20 minutes, while at seven days the tensile strengths of the respective cements may be equal.

The quality of rapid hardening is particularly acceptable to the cement user—it enables him to proceed with his work at high speed, because in 18 or 24 hours his concrete is strong enough to bear the weight of superincumbent material—it reduces the amount of shuttering required, and it produces a concrete or mortar that is less liable to damage by frost, sun and wind.

Tests for rapid hardening are indeed the only tests applied to cement by the "man in the street" or his technical relative, the navvy, and a concrete that will bear his weight "the next morning" earns his commendation and stamps the cement in his mind as satisfactory.

Many manufacturers are entirely indebted to Nature for this desirable feature of their cement, because it is due to certain characteristics of the raw materials used in its manufacture, but there is hope that scientific research may be able to point the way to a general improvement in this respect which will be applicable to all cements.

The conclusion is thus reached that although the British Standard Specification has been instrumental in levelling up the quality of cement produced throughout the United Kingdom, there is still justification for preferences in connection with brands of portland cement.

So far as the export trade in cement is concerned, the brand is of great importance. In many countries there is no standard specification, and facilities for cement testing are almost non-existent, so that the cement user has only the brand to guide him as to the quality of the material he buys. It is in such cases as these that the reputations for good quality established by some manufacturers last century and steadily maintained since, have been of benefit not only to the manufacturer but also to the user abroad.

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# Cement Imports Into Santiago Decreased

The diminution in imports of cement into the Santiago district of Cuba from the United States is due principally to the suspension of building operations, owing to the financial crisis and economic depression, which Cuba has been experiencing for the past six months, with increasing intensity up to the present time, rather than to foreign competition in prices and freight rates, according to a report from Consul Harold D. Clum, at Santiago.

Santiago is one of the principal export markets for cement of American manufacture. Importations of cement at that port in the first three months of 1921 were only 3,573,884 lbs. from all sources, as against 19,042,815 lbs., all from the United States, during the first three months of 1920. Statistics furnished by the Santiago custom house show that of the total of 3,573,884 lbs. imported during the first quarter this year, a half, or 1,703,576 lbs., came from the United States, 1,672,308 lbs. from Germany and 198,000 lbs. from Belgium. No imports were reported from Netherlands, Canada, Jamaica, and Spain, as in 1920.

The conclusion drawn by Consul Clum, however, that competition has not affected imports from the United States, does not take into consideration the fact that imports from Germany during the calendar year of 1920 totaled only 38,808 lbs. of cement, while imports from Germany as shown above in the first three months this year totaled 1,672,308 lbs. If competition is not a factor now, it probably will prove to be very important when the Cuban market for cement revives.

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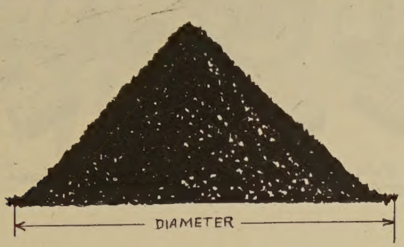
[1] From *Concrete and Constructional Engineering.*

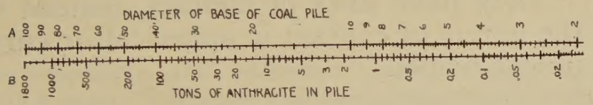
# How Many Tons in a Conical Pile of Anthracite Coal?

By W. F. Schaphorst

Because of the fact that when anthracite coal is piled loosely on the ground or on a floor it assumes a fairly definite angle of repose, we can easily develop a formula for computing the number of tons in a natural conical pile. The weight of anthracite per cubic foot is a fairly constant quantity, also, which makes the development of the formula easier.



Such a formula has been developed, but it involves squaring the diameter of the base of the pile and multiplying by a constant. To make the method as easy as possible, the writer therefore constructed the accompanying chart, which gives the tonnage direct by simply glancing from line *A* to line *B*.



For example, how many tons of anthracite coal in a conical pile whose base diameter is 30 ft.?

Find the 30 in line *A* and glance down to line *B*, and there's the answer—about 48 tons.

Inversely, the chart can be used to determine the size of plot needed for the storing of a given amount of anthracite coal.

For example, what size of plot will be needed for the storing of 200 tons of anthracite coal?

Find the 200 in line *B* and glance back to line *A*. The answer is—about 49 feet.

The range of the chart, it will be noted, is great enough to take care of most ordinary piles. It varies from 2 to 100 ft. in diameter. In a 100 ft. pile there would be about 1,800 tons.

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# Europe Undersells U. S. on Cement and Steel in Cuba

Edelmiro Felix, secretary of the E de Construciones y Urbanizacion, building interests of Havana, who left New York recently to place orders for building material in Europe, asserted that Germany is underselling the United States on cement, and that France and Belgium are underselling us on steel in Cuba, according to the *New York Journal of Commerce*. He said:

"We have found that we can buy cement in Germany at $3.80 a barrel, while we are being asked between $6 and $7 for it in the United States. Belgium and France, particularly Belgium, are selling steel so cheaply that we can buy it there and have it laid down in Havana at a less cost than if we purchased it in the United States."

# Rules for Boiler Plant Maintenance and Operation

Concise rules followed by the firemen of 28 local firing boiler plants in the Middle West, with remarkably good results, are given as follows by E. H. Tenney, chief engineer of power plants of the Union Electric Light & Power Co., St. Louis, in a letter published by the *Electrical World:*

1. Stop all air leaks in boiler settings and flue doors. Leaks can be very easily found with a lighted candle. Air should be admitted to a furnace through the fuel bed and at no other place.

2. Keep boiler tubes free from soot and scale, both inside and outside. Special attention should be given to the regular cleaning of flues and tubes.

3. Keep side walls and bridge walls free from ashes and clinkers; these retard the draft, cut down the available grate surface and cause a waste of fuel.

4. Keep ash pits cleaned out at all times; if they are full of ashes, not only is the draft retarded, but also the grate bars are burned out more quickly.

5. Experiment to determine the draft required to burn the fuel to the best advantage.

6. Fire little and often rather than a large amount less frequently. By such firing it is easier to prevent holes from forming in the fire and better fuel economy results. Holes appearing in the fuel bed should be immediately filled up with fresh coal.

7. Do not fire large lumps of coal. These should be broken up to the size of a man's fist before firing. Air holes form around a large lump, and it is also harder to spread an even fire with large lumps than with smaller pieces.

8. Use the poker or slice bar as little as possible to minimize carrying unburned coal down into the ashpit.

9. Watch the ashes after clean-out periods, to determine whether all the coal is being consumed as well as it can be.

10. Use the damper as much as possible to control the fire and the steam pressure.

11. Keep the hand-fired grates or automatic stokers in repair at all times. Be sure the grate bars are not warped and twisted out of shape, allowing coal to fall through into the ash pit. Be sure the fronts around stokers are not allowing excess air to go into or over the fire.

12. Use draft gauges on boilers. Determine the draft which gives the hottest fire and maintain it at all times.

13. Keep no more boilers on hot banks than are absolutely necessary to carry the load during a peak. Be sure that the boilers are banked in the most efficient manner.

14. Keep the steam leaks about the plant down to a minimum and give special attention to see that all small valves, drips, drains, and traps are tight and not leaking live steam.

15. Make sure that the most is got out of the exhaust steam from pumps and auxiliaries. See that the overflow valve on feed-water heaters is not leaking and wasting hot water.

16. Keep the boiler in fit condition by thorough cleaning and repairing. A boiler should never be put back on a load after having been taken down for cleaning or repairs until it has been thoroughly inspected and all defects have been remedied. Irregularities noticed in any boiler during the time it is on the load should be noted in the log, in order to be sure that they are taken care of when the boiler comes down for cleaning or repairs.

17. A plant should at all times be clean. A dirty and ill-kept plant is virtually always an inefficient one. A clean plant not only indicates that the plant is being cared for, but that the man in charge is trying to run the plant efficiently.

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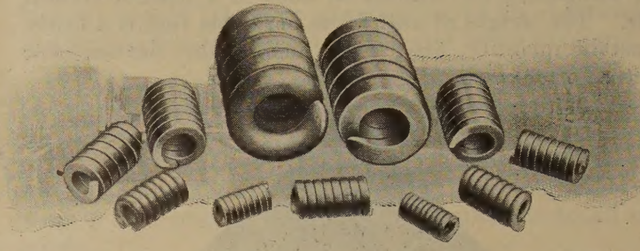
The first fall meeting of the Lehigh Valley Section of the American Society of Mechanical Engineers was held in the lecture room of the physics laboratory, Lehigh University, South Bethlehem. Papers were read on "The Utilization of Waste Heat in Steel Mills," by A. T. Lewis, of the Bethlehem Steel Company; "In Cement Mills," by Joseph Brobston, vice-president of the Dexter Portland Cement Co., Nazareth; and "In Power Plants," by H. R. Smith, of Philadelphia, connected with the Babcock & Wilcox Co., of Bayonne, N. J.

# HELIPEBS

## for tube mills



"HELIPEBS" Patented in U. S. A., Mexico, Canada, Japan, and all the principal Countries and States of the World

"Helipebs" are grinding bodies that have made unusual records of economy and efficiency in tube mills in cement plants.

They are small coils of steel wire, each in the form of a helix, hardened by special process.

They are designed to produce a sliding action in operation — they align themselves with their longer axes at right angles to the mill axis and fall endwise at top of lift.

"Helipebs" are hollow. Bulk at less weight, save power.

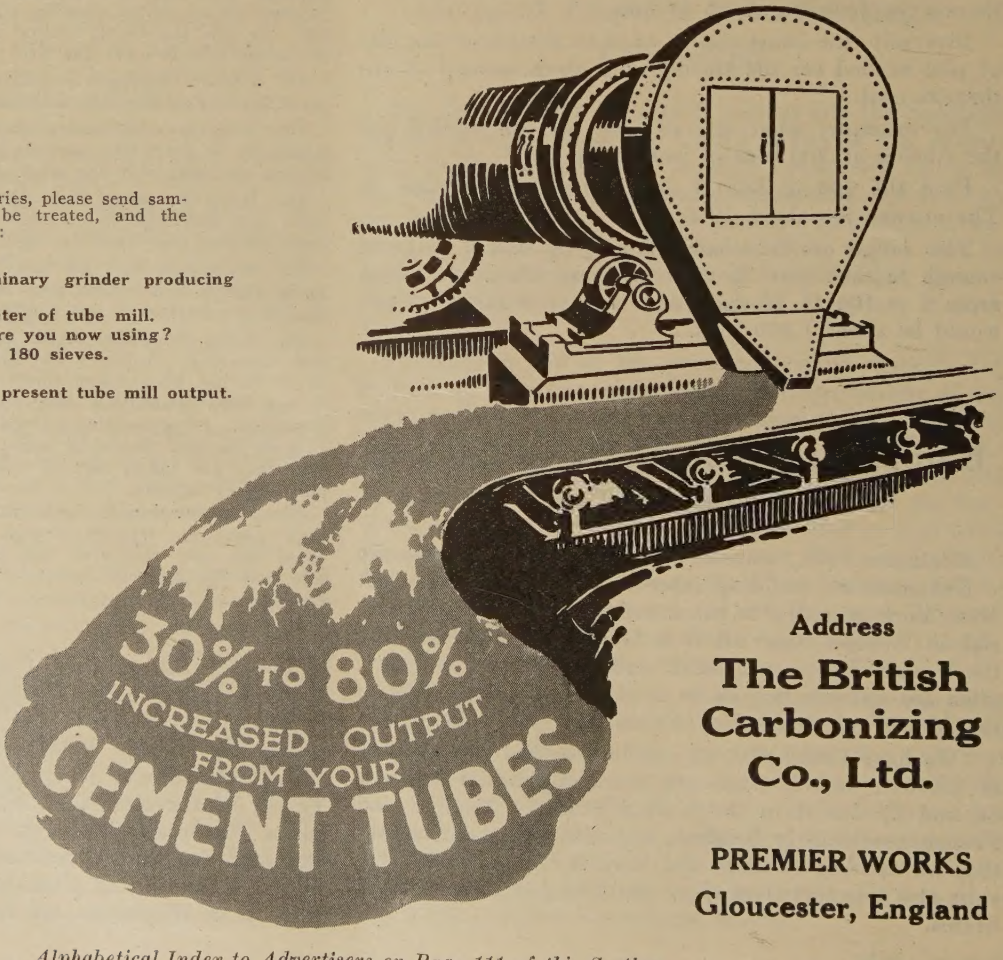
They act as elevators, carry the material treated to the top of lift and distributing it between the faces of the "Helipebs."

They have lines of contact, instead of the points of contact in spherical or curvilinear bodies.

Using "Helipebs" requires no change in equipment—simply substitute the new charge for the old.

In submitting inquiries, please send samples of material to be treated, and the following information:

**Facts regarding preliminary grinder producing tube mill feed.**
**Type, length and diameter of tube mill.**
**What grinding media are you now using?**
**Feed residue on 76 and 180 sieves.**
**Tube mill R. P. M.**
**Volume and fineness of present tube mill output.**



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